Gas Journal

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Editorial Notes

New Field for Coke

In the course of our notes on the subject of coke marketing in these columns last week we made passing mention, among the many new loads which are being developed to provide further outlets for our solid smokeless fuel, of a process which may well have great future possibilities in the agricultural industry. We refer to the artificial drying of grass by means of coke-fired plant, details of which are given on later pages of this issue.

In England and Wales we have some five million acres of grassland producing a little over a ton of hay per acre a year. If one-tenth of the product from this pasture land were artificially dried to produce a material of high feeding value for livestock it would necessitate the use of 300,000 tons of coke. Besides the advantages of being able to cut and dry the grass almost irrespective of weather conditions—a very important consideration in a summer the earlier part of which may be similar to the one through which we have just passed—it has been found that the artificially dried product retains practically the full feeding value of the fresh pasture grass. Grassland has up to the present been largely utilized for grazing and producing hay for winter foodstuff. Hay is, however, of low food value, and therefore for winter feeding it has to be supplemented with expensive cattle cake and concentrated food. The low food value of hay is due to bleaching, washing out of soluble salts, and fermentation in the stack, resulting in the loss of such essential constituents as protein, minerals, starch, and carotene. When grazed on pasture grass in summer livestock thrive better than when fed in the winter on hay and concentrated food by reason of the fact that these essential constituents are more valuable than those added artificially in the form of concentrates. Young grass, properly dried, retains in a natural state the full feeding value and health-giving properties of fresh grass and is capable during the winter months of fattening stock and providing the necessary food for high yielding cows.

Machines which have been developed for grass-drying generally comprise an enclosed chamber into which the grass is introduced on trays or passed through on endless conveyors. Adjacent to the drying chamber is a coke-fired furnace or producer, providing the hot gases which are drawn through the drying chambers by means of fans. Between the furnace and the fans the gases are mixed with cold air to reduce the temperature to about 300° F., which has been found to be a suitable temperature for drying. Another type of drier is comprised of a long tubular drying chamber through which the grass is drawn in a strong current of hot gases. Coke is particularly suitable for these plants as the freedom from smoke ensures that the product is dried without contamination. The drying period varies, of course, with the type of plant and the moisture content of the grass, but it averages twenty to thirty minutes. A typical plant produces one to one and a half tons of dried grass per eight-hour day, and requires from 10 to 15 cwt. of coke per ton of grass dried.

There are undoubtedly great possibilities for the Gas Industry's coke market in these developments, and if the artificial drying of grass in this way is considered in conjunction with the research work which has been carried out during the last few years, much of it by the London and Counties Coke Association, with the object of improving the quality and productivity of agricultural land, the results may be very far-reaching.

Oil Production

The Annual Report of the Secretary for Mines for 1935, which has just been published, includes statistics of the production of light oils from indigenous materials during the year. The total production of refined light oils obtained by hydrogenation and at gas-works, coke ovens, tar distilleries, and low-temperature carbonization works amounted to 79 million gallons. Of this quantity 66 million gallons was refined motor spirit. These figures compare with a total production in 1934 of 50 million gallons of refined light oils, of which 40 million gallons was motor benzole. The Scottish shale oil industry produced a little over 10 million gallons of motor spirit compared with 14½ million gallons in 1934. Due to the increase in the duty from 1d. to 8d. on imported heavy oil used in motor road vehicles, considerable changes took place in the proportions of the various refined products. As a suitable diesel oil can be produced from shale oil, there has been a marked increase in the make of this product at the expense of motor spirit and fuel oil. On balance, however, the change is advantageous to the industry.

Of the 66 million gallons of refined motor spirit from

coal and coal products, coke ovens make the largest contribution—26¼ million gallons. This was followed by an output of 20¾ million gallons of coal petrol by the hydrogenation process, 10½ millions at tar distilling works, and 8½ million gallons at gas-works. It is interesting to note that the output of refined motor spirit from gas-works increased in 1935 by over 16% as compared with the previous year. On the basis of coal carbonized at gas-works, those which extracted benzole represented 44·4%, compared with 37·5% in 1934. Moreover, the average yield of crude benzole per ton of coal carbonized at gas-works which extracted spirit increased from 2·02 gallons in 1934 to 2·16 gallons in 1935. The output of refined motor spirit from coke ovens increased in 1935 by 7·5%. On the basis of coal carbonized, those coke ovens which took out benzole represented 97·6% of the total. The average yield at coke ovens increased very slight—3·03 gallons per ton of coal in 1935, compared with 3·01 gallons in 1934. The Report mentions that at some of the new ovens the yields are much above the average.

In regard to low-temperature carbonization, 13 plants were in operation as compared with 9 in 1934. Three were coke ovens operated at a medium temperature (up to 800° C.) with a combined throughput of 13,000 tons per annum, including in one case a proportion of tar used in admixture with crushed coal. Other semi-low temperature ovens were installed in 1935, but owing to the great demand for metallurgical coke, they were operated at high temperatures. The amount of coal carbonized increased by 15·1% over 1934. This resulted in the following increases in products: Smokeless fuel 17·9%, tar 12·9%, gas 12%, and crude spirit scrubbed from the gas 14·4%. Mention is made in the Report of the increased purchase of coke oven gas by gas undertakings—from 18,052 million cu.ft. in 1934 to 20,474 millions in 1934. There is also a reference to the use of compressed gas for motor transport. The latest information available shows, however, that only 17 gas fuel vehicles (goods) are registered, including one for petrol and coal gas fuels.

Effluents—Gaseous and Liquid

Since the Chemical Engineering Congress of the World Power Conference we have on several occasions referred to the Papers which were presented. Comment on current events is given pride of place in these columns and has made it necessary to postpone some of our observations on the Papers. Further thoughts on the Congress may appear tardy, but there were so many good things in the proceedings that we return to the subject without apology. It was, for instance, a happy thought to include effluents among the problems discussed, for few are the chemical works that do not produce some variant of the classic description of dirt—matter in the wrong place. Mr. W. A. Damon and Dr. Birkett Wylam, co-operating in a Paper on gaseous effluents, opened by paying a veiled tribute to the work of the Gas Industry in their remark that "the gaseous effluent which is discharged in the greatest quantity and over the widest area is smoke. For many generations, public agitation against the smoke nuisance has been going on, but in spite of scientific investigation and legal enactments, the nuisance continues almost unabated up to the present day. Much has been done to prevent the emission of large volumes of industrial smoke, but the domestic problem has scarcely been touched."

It is a pertinent commentary on these weighty words that certain Members of Parliament who not long ago discussed smokeless fuel in *The Times* did not show any particular vivid interest in the major problem of cleansing the atmosphere and so promoting the health of the community, but were mainly concerned with discovering whether, if house coal were to be replaced by smokeless fuel, the consumption of coal would be increased. As one M.P. put it, the continued obscurity (regarding the answer to this question) "might well lead to disappointment among the miners and to an unnecessary waste of the money of the public." The inference is clearly that if smoke abatement is not to increase the consumption of coal, then it is waste of public money endeavouring to bring it about.

A useful warning is given that in considering waste gas problems, regard should be had to the toxicity of the gases that are escaping. The toxicities of some of the gases met with in gas-works were given in the Paper. Expressed in maximum parts per million in air that may be inhaled for one hour without danger, these are: Sulphuretted hydrogen, 200 to 300; carbon monoxide, 400 to 500; sulphur dioxide, 50 to 100; ammonia, 300 to 500; carbon disulphide, 480 to 800; benzene, 3,130 to 4,700. It is well here to repeat a remark that was made regarding rescue work in presence of sulphuretted hydrogen. A chemical manufacturer stated that out of 100 cases of gassing with H_2S he had never lost one man, his reason being that he continued artificial respiration long after even a doctor had given up the patient; sometimes that involved 7 or 8 hours work, but the gassed man always recovered.

Among the chemical works mentioned, the authors specifically referred to distillation processes, and they regard the escape of coal gases when charging retorts or coke ovens as noxious effluent, the escape of which should be prevented. This is described as "dense clouds of acrid smoke," the discharge of which, at many installations, is said to occupy from 20 to 35% of the total time. The case is noted (which we believe refers to Beckton) of "a coke oven battery near London which, to all intents and purposes, is smokeless." This is said to be the only instance of a completely successful attempt to abate the "green gas" escape.

Most of the Alkali Inspector's strictures and admonitions relating to carbonization are in respect of tar and benzole plants. The escape of sulphuretted hydrogen from tar plants, the Authors suggest, must be prevented either by an oxide or lime purifier, or the uncondensed gases, if small in volume, may be passed through a safety seal pot into the still furnace. The end of the condenser of the benzole plant should be connected to the gas mains before the exhauster, if a crude plant, or for a rectified still should be vented through the roof into a washer fed with wash oil. It is advantageous also to couple up all vents from storage tanks into the tail gas system so as to recover benzole which may have evaporated. A long section of the Paper is devoted to sulphuretted hydrogen with particular reference to sulphate of ammonia plants, and the methods for treating the gas are summarized as combustion, with absorption of the SO_2; absorption in iron oxide; or treatment in a Claus kiln. In general the impression gained from the Paper is that it correlates the data regarding processes at present used in chemical industry, and, moreover, that the elimination of noxious gases from the atmosphere, with the single exception of those derived from the combustion of coal, is a good deal more advanced than the parallel problem of eliminating liquid effluents.

Water Pollution

THE prevention of liquid effluents from polluting rivers and other water courses is clearly one of the world's problems. In America it is recorded that the problems of stream pollution by industrial wastes and domestic sewage are outstripping the best efforts of those whose function it is to effect an economical and rational balance between sensible and regulation and industrial enterprise. In Great Britain the legal situation is far from satisfactory since every Act of Parliament that has seemed to promise powers that would ameliorate the position has been so much whittled down in the process of law-making that in effect it has no value for the purpose for which it was designed.

The first really substantial move resulted from the pollution of streams, not hitherto polluted, by effluent from the newly established beet sugar industry in 1927. This gave rise to the formation of the Water Pollution Research Board, having as its prime object research into problems of water pollution, and to assist manufacturers having problems of this character. The text of the Congress Paper by Dr. H. T. Calvert on this subject is that the first stage in any pollution problem must be to ascertain if the quantity of effluent or its total pollution value cannot be reduced, and frequently the reduction is found to be possible by means which add to the profit-making power of the concern. This may be done by using the water for more than one purpose, or by recovering the polluting constituents in the form of substances of value. When all possible has been done at the works, the recommended procedure is to discharge the effluent into the public sewers. Unfortunately the obligation which was laid upon the sewage authorities to admit industrial waste waters by the Acts of 1875 and 1876 has been hedged about by so many restrictions as to be worthless to the industrialist. In some instances local Acts of Parliament have been obtained under which the discharge of liquid effluents into the public sewers is facilitated. Safeguards are usually included such as the retention by the manufacturer of any substances which would injure the sewers or upset the working of the process of sewage disposal adopted at the sewage works, and the regulation of the flow so that it does not reach the sewage works in large processes. A payment for the facilities afforded to the manufacturer is also usual.

These facts are of peculiar interest to the gas engineer, but it is not a little surprising that throughout the Congress there was no mention of the research conducted by The Institution of Gas Engineers which, when put to practical use, has had a valuable effect in promoting the treatment of gas liquors by sewage works. It will be remembered that the 5th Report of the Liquor Effluents Committee, after practical trials at Leamington, came to the conclusion that normal doses of either crude or spent liquor can be dealt with at sewage works. In America, according to a Paper by W. L. Stephenson, gas-works liquors are discharged into the river containing not only the usual phenols and similar bactericides, but also tar and light oils. These are separated by passage through tar so that the emulsified tars may be removed by the tar already separated; where this is insufficient the oils are further precipitated by chemical methods involving the addition of iron sulphate and lime followed by filtration in sand or coke filters, and finally, if phenol is present, it is removed by the benzole scrubbing method. American by-product coke ovens have abandoned the use of waste liquor for coke quenching on account of the corrosion of equipment, and now treat waste gas liquors for removal of phenol either by evaporation of the phenol in large volumes of steam or air, or by use of the benzole-scrubbing method.

Inducements

WHILE it is doubtless true that many considerations may influence the choice of a site for a new factory, an adequate and cheap source of power and heat must have its weight in bringing about a decision. A supply of gas adequate beyond any trace of suspicion should be available wherever a contemplated site is within reach of an existing gas-works, but business-getting tariffs are not so frequently met with as they should be, in spite of the efforts put forth by many—the "JOURNAL" among them—to secure an increase in the output of gas by this unfailing means. The column of the "JOURNAL" DIRECTORY giving particulars of prices shows that discounts, rebates, and special rates of one kind or another, are becoming more and more prevalent as time passes, but is there not still ample scope for what may be termed real business-getting gas tariffs in the industrial field?

It may be the case that a new factory is not coming into existence every minute, but in times of business revival like the present the multiplication of premises in which manufacturing operations are to be carried on becomes rapid, and those gas undertakings that have put themselves in a position to influence favourably—even if in no more than some small degree—the choice of sites for such premises are to be congratulated. A tempting industrial gas tariff as an inducement, where other factors are equal, might possibly prove to be the deciding consideration in the selection of a factory site, and if, in the majority of instances, the matter cannot be put so high as this, it must still be worthy of the earnest thought of all gas administrators. It has just been reported by the Board of Trade that during the last year 510 new factories were opened, that 192 factories were extended, and that 486 were closed down. As a matter of fact, these figures do not vary very greatly from those of the preceding year, when things were, in some directions, beginning "to look up," so that the change-about of factories is an important problem. The figures take no account of the new establishments employing less than 25 persons.

The regional distribution of the new factories is, of course, interesting, and largely in favour of Greater London, though the report remarks that there is no evidence of a "drift of industry to the South" in the sense that new factories in the South are the result of transfer from the North. From the point of view of what we have been saying here, however, the report is of particular interest in that an attempt has been made in it to obtain some information as to the motives which influence industrialists in the choice of sites for their factories. A cheap and adequate source of heat and power does not figure among the main motives which find a place among seven headings, where "convenience of premises" accounts for by far the greater number, while the motive in the smallest proportion of cases is "proximity to employer's residence." Another heading of "main motives" accounting for a small number of cases is "cheap land, low rent, or low rates," and who shall say that a tempting industrial gas rate is not included in some of these main motives, as well as to a lesser extent in other cases? The report affords proof that there is gas business in the industrial field.

Personal

Mrs. EILEEN MURPHY, Home Service Director, British Commercial Gas Association, was involved in a road accident while on holiday last week, receiving injuries to the head and face. It is anticipated that she will be in the hands of the doctor for some time.

* * *

On the occasion of his departure for Cinderford, where he has been appointed Engineer, Manager, and Secretary, Mr. THOMAS PORTER, who has been in the employ of the Stranraer Gas Company for the past twelve years, was the recipient of a suitable presentation and the good wishes of the staff, which were ably expressed on their behalf by Mr. William Young, Manager and Collector. Mr. Porter briefly replied.

* * *

Mr. N. C. W. ALLIN, Technical Assistant, has been recommended by the West Bromwich Gas Committee for the position of Assistant Engineer and Manager in succession to Mr. D. Green, who has been appointed Engineer and Manager. The son of the late Mr. J. W. Allin, formerly Gas Engineer at West Bromwich, Mr. N. C. W. Allin was made Junior Technical Assistant of the Department three years ago.

* * *

On Saturday, Aug. 29, at St. Michael's Parish Church, Bishop's Stortford, Herts., was solemnized the marriage of Mr. Harold O. Davey, of Plymouth, to Miss Winifred Robinson, only daughter of Mr. and Mrs. FRANK H. ROBINSON, of Bishop's Stortford. Mr. Robinson is the Engineer and Manager of the Bishop's Stortford, Epping, and District Gas Company, and for many years held a similar position with the Harrogate Gas Company.

Obituary

The Late Mr. S. B. Chandler

An Appreciation by Capt. W. J. Liberty.

I regret that circumstances prevented my paying my last tribute at the interment at Nunhead last Monday of my personal friend, S. B. Chandler. From his entry into the Industry I had known him intimately, more especially in connection with the London and Southern District Junior Gas Association. In my Presidential years of the Association (1908-1910) I had the pleasure and privilege of receiving him into Membership, and only last June, at the Annual Meeting of the Senior Association, he once more reminded me of the circumstance. He was then a young man of 25 years of age, at the beginning of his career in the Industry, with the South Metropolitan Gas Company; but even then I discerned in him those qualities which would, and eventually did, bring him into the forefront of the Industry, to which he unselfishly devoted himself. As his cousin, Mr. Dean Chandler, aptly put it, he had given of his best to further the interests of the Industry."

The outbreak of war in 1914 found Mr. Chandler in the Chair as President of the London Juniors, and he exhibited that courage typical of the man by remaining President for five years and keeping the newly formed Association from falling to pieces.

Gas Journal Shewring Fund

Donations are invited to the Fund, full particulars of which were given in the "JOURNAL" for July 22. The Management of the Fund is in the hands of Messrs. F. G. Shaw (Buxton), W. W. Townsend (Colchester), and J. Bridge (Elland). All expenses having been guaranteed, the whole of the sums received will be applied, without any deduction whatsoever, to the benefit of the widow and children of Harold Shewring, by whose tragic death earlier this year they were left in distressed circumstances.

Cheques should be made payable to the "GAS JOURNAL," and crossed "Shewring Fund Account." All donations will be gratefully acknowledged by the Editor, who is Treasurer to the Fund.

We are pleased to state that the total of the Fund is now over £350.

Correspondence

Water Heater Governors

SIR,—Having introduced some years ago the first multi-point heater with embodied gas governor in this country, I am glad to see that the importance of this device for water heating has found such appreciation, as shown in the Paper by Mr. Masterman at the last Institution meeting, and recently in the article by Mr. L. Friedman in the "GAS JOURNAL" for Aug. 5 last. The latter details the performance and characteristics of the constant volume type of governor, as against the constant pressure type. I cannot, however, agree with the final conclusion—that in the case of the instantaneous heater constant volume governors should be given preference.

Full advantage of a gas governor combined with a water heater cannot be taken if a commercial type of governor is fitted before the appliance. The governor should be specially adapted to the characteristic conditions and the purpose intended. It should be considered as integral with the heater, and not as a separate part. Hence it seems to me advisable not to compare a pressure governor with a volume governor, but a heater embodying a volume governor with a heater embodying a volume control pressure governor.

In this way one arrives at aspects different from those outlined in the article. Since the gas rate of the instantaneous heater is constant, it is easy to design a pressure governor which gives practically a constant outlet pressure, as mentioned.

The opinion that the elimination of the leather diaphragm implies definite progress appears exaggerated, considering the millions of gas meters doing their work satisfactorily for long periods and often under very unfavourable conditions. The right quality of leather and its correct treatment are, of course, essential.

The position of the embodied pressure governor when favourably chosen will simplify its working conditions considerably. When this governor is inserted between the burner and the gas valve operated by the flowing water, gas reaches the governor only when water is taken from the heater. The diaphragm, therefore, is not exposed to any gas pressure during most of the time. The leather diaphragm in gas governors has been used for more than a hundred years; the metal float, however, as described in the article, is a rather new element which apparently calls for much higher accuracy in manufacture, as it should glide with a certain amount of friction on the guide tube. It would be interesting to learn if experience is available of such a device used for a considerable period where the gas may contain at times particles of dust or rust from the pipes, or where it is inclined to deposit gum.

In this connection it should be borne in mind that with the volume governor operating on a rather small pressure difference, the force available for moving the float is very small in comparison with that obtained with a pressure governor operating against the atmosphere.

Another advantage of the pressure type governor is the ease of adjustment of the gas flow to meet differences in calorific value and specific gravity of the gas. This can be done merely by screwing in or out the top of the controller, so altering the pressure of the governor spring. On the volume governor, however, as described, exchange of internal parts is necessary.

One of the objections brought forward against the pressure governor is its performance in the event of enlarged burner holes. The Author, however, considers only one side of the picture. I should like to ask fitters experienced in the maintenance of water heaters if they have found more pin-hole burners with enlarged holes than with holes partly or completely blocked by deposits which have fallen down from the fins or by particles brought in by the gas supply. Fitters' instruction to clean the burner periodically seems to supply the answer. What, however, happens if the burner holes are diminished or blocked? As seen on burners which have been in use for some time, this blocking does not occur uniformly. Some holes are in their original condition, while others have become smaller or are even completely blocked. With a volume governor maintaining a constant gas outflow irrespective of alterations of the openings, the whole amount of gas may have to pass through a considerably decreased number of burner holes, so creating flames of excessive length which can cause trouble by sooting, incomplete combustion, &c. On the other hand, with a pressure governor maintaining a constant gas pressure before the burner, the decrease in the size of the burner holes will result in a reduction of the gas flow, and this seems to me to be safer.

Yours, &c.,
W. MARX.

26A, *Peterborough Road, S.W. 6.*
Aug. 25, 1936.

News in Brief

The Public Lighting Contract at Ballinasloe has been awarded to the Local Gas Company by the Urban Council.

The First Prize in the Local Carnival in aid of the hospital was won by the Weston-super-Mare and District Gas Company with an original entry. A boy dressed as Mr. Therm stood on the top platform of the lorry and threw confetti and streamers into the crowd.

Interim Dividends at the following rates (less tax) are being paid by the Hastings and St. Leonards Gas Company—namely, £7% per annum on the 5% converted stock, £5 10s.% per annum on the 3½% converted stock, and £6 8s.% per annum on the 5% additional stock.

Applications are Invited by the Leamington Priors Gas Company for the position of Secretary and Accountant which will become vacant on Sept. 30 through the retirement of the present Secretary, Mr. W. E. T. Hems, after more than 60 years' service. The commencing salary is £375 per annum rising to £400 after twelve months' satisfactory service.

Continuing Their Extensions into the more remote districts of their now greatly enlarged area of supply, the South Suburban Gas Company have obtained a street lighting contract in the little Kentish village of Downe—famous as the home of Charles Darwin—and the first gas lamps, automatically operated by clock controllers, came into action a week or so ago.

Two Changes in Calorific Value are announced in the current issue of the *London Gazette*. The Mossley Corporation give notice that from Jan. 1, 1937, they intend to supply gas of 500 B.Th.U. instead of 511·8 B.Th.U. per cu.ft. The Narborough, Blaby, Enderby, and Whetstone Gas-Light and Coke Company announce that on and after Oct. 1, 1936, they intend to supply gas 450 B.Th.U. instead of 460 B.Th.U. per cu.ft.

The Institution of Gas Engineers

Change of Address

We are informed by the Secretary of The Institution of Gas Engineers, Mr. J. R. W. Alexander, that all the meetings of the Institution and its various committees, which are to be found in our Forthcoming Engagements Column, after Sept. 29 will be held, except where otherwise stated, at the new address of the Institution:

1, Grosvenor Place, London, S.W. 1.

The new address, 1, Grosvenor Place, is situated next to St. George's Hospital at Hyde Park Corner at the junction of Grosvenor Place and Grosvenor Crescent, the entrance being in Grosvenor Crescent. The Meeting rooms and Institution Library are on the first floor in the old section of the building; the Institution Offices adjoin on the first floor of the new Section. The present Telephone Number (SLOane 8266) will not be changed.

Gas Floodlights Open-Air Swimming Pool

Effective Installation at Chingford

A very fine system of gas floodlighting has recently been completed at the Larkswood open-air swimming pool at Chingford, Essex, where the area of water amounts to 24,300 sq.ft.

The pool itself is illuminated by fourteen 12-light "Kempar" floodlamps, while six further lamps are fixed at various points to light the immediate surrounds, splash pools, and showers. To illuminate the spectators' terraces and the approach road to the pool nine Sugg's "Rochester" lamps have been erected. The pool lamps are mounted on concrete columns, the line of mantles being 12 ft. high and 8 ft. 6 in. from the water's edge. Each lamp is equipped with a G.L.C. constant-pressure governor, "Comet" lighter, and Horstmann switch—thus giving separate control for each lamp, so that when the work of bath cleaning is in progress one or more of the lamps may be used without lighting the whole system.

The installation was carried out by the Gas Light and Coke Company, and the lighting effect is excellent, a high standard of illumination being provided over the whole area.

Three Years of Progress at West Bromwich

A Tribute to Mr. J. Hunter Rioch

At a meeting of the West Bromwich Gas Committee held on Aug. 21 a resolution was unanimously passed placing on record their appreciation of the valuable and efficient services of Mr. J. Hunter Rioch as Gas Engineer and Manager over a period of three years.

The Chairman (Alderman J. E. Cox, J.P.), in moving the resolution, spoke of the re-organization of the Undertaking which had been carried through, and also stated that when Mr. Rioch took charge the annual make of gas was approximately 515 million cu.ft., whereas for the year just ended it was 570 million cu.ft. Mr. Rioch had taken a keen interest in the younger members of the staff and had been successful in fostering the team spirit so essential to progress.

The resolution was supported by several members of the Committee, and the Deputy Chairman, Alderman W. T. Poultney, J.P., remarked that Mr. Rioch's services had been an epoch making three years.

Forthcoming Engagements

Sept.

7.—GAS COMPANIES' PROTECTION ASSOCIATION.—Committee Meeting at 3.15 p.m.

8.—BRITISH GAS FEDERATION.—Meeting of Exhibitions Committee, 28, Grosvenor Gardens, S.W. 1, 12 noon.

8.—N.G.C.—Meeting of the Central Executive Board at 2.30 p.m.

10.—NORTH BRITISH ASSOCIATION.—Annual Meeting at Kirkintilloch.

11-15.—WOMEN'S GAS COUNCIL.—Summer School for Demonstrators at the Domestic Science College, Cardiff.

14.—I.G.E.—Research Executive Committee at 2.30 p.m.

15.—I.G.E.—Gas Education Executive Committee at 2.30 p.m.

16.—B.C.G.A.—Executive Committee Meeting, 12 noon; General Committee Meeting, 2.30 p.m.

17.—I.G.E.—Refractory Materials Joint Committee at 2.30 p.m.

24.—WALES AND MONMOUTHSHIRE ASSOCIATION.—General Meeting at Porthcawl.

25.—NORTH OF ENGLAND ASSOCIATION.—Autumn Meeting at Middlesbrough.

Oct.

2.—I.G.E.—Liquor Effluents and Ammonia Committee at 11.15 a.m.; Joint Research Committee at 2.30 p.m.

3-6.—B.C.G.A.—Jubilee Conference at Bath.

5.—I.G.E.—Joint Lighting Committee at 2.30 p.m.

6.—I.G.E.—Research Executive Committee at 2.30 p.m.

12.—I.G.E.—Finance Committee at 1.45 p.m.; Membership Committee at 2.15 p.m.; General Purposes Committee at 3 p.m.; Benevolent Fund Committee of Management at 4.30 p.m.

12.—WOMEN'S GAS COUNCIL.—Executive Committee at 11.30 a.m. Branch Secretaries meeting at 2.30 p.m.

1936 "JOURNAL" DIRECTORY

Page 2. ALFORD. H. Preston appointed M., vice G. K. Barrs.

Page 16. CINDERFORD. T. Porter appointed E., M., and S., vice A. Goodes

Page 32. HAYWARDS HEATH. A. E. Whitcher appointed M.D.

Page 36. ILKLEY. H. Jack appointed E., M., & S.

Page 36. IRTHLINGBOROUGH. Undertaking acquired by Wellingborough Gas Light Company.

Page 146. IRISH ASSOCIATION. L. W. Dalby (Kilkenny) elected Hon. Secretary and Treasurer, vice G. Airth, retired.

"Model Engineer" Exhibition

Gas Fitter Among Competitors

Among the entrants in the competition sections of the "Model Engineer" Exhibition, to be opened by Mr. Hore-Belisha, Minister of Transport, at the Royal Horticultural Hall, Westminster, on Sept. 17, is Mr. J. W. Lampard, a gas fitter, of 1, New Road, Mill Hill, N.W. 7.

He has constructed a ½-h.p. water-cooled stationary 2-stroke engine, adapted for town gas. It is approximately 1½ ft. square, and all the parts, with four exceptions, have been made by the competitor. It runs, he says, at as low as 150 revolutions per minute and fires regularly.

Public Lighting Engineers' Conference

British Gas Federation Stand

The British Gas Federation is to be represented at the Public Lighting Engineers' Conference at Cheltenham on Sept. 7-10 by an Information Bureau.

Photos of gas street lighting installations and graphs showing the consistency of the light over certain stretches of main roads will be displayed. On the back of the stand three enlarged photographs of a technical nature will be shown, and there will also be exhibited the new control fitting for tall columns.

Copies of the photographs and booklets dealing with gas lighting will be available for those interested.

North British Association of Gas Managers

Programme for Annual General Meeting

The headquarters of the North British Association of Gas Managers for their Seventy-Fifth Annual General Meeting on Thursday, Sept. 10, will be at Kirkintilloch, where their President, Mr. James Dickson, is Engineer and Manager of the Gas Undertaking.

The opening meeting will be held in the Town Hall at 10 a.m. on the Thursday, when Mr. Dickson will deliver his Presidential Address. He will be followed by Mr. John M'Isaac, Superintendent of Industrial Sales, Glasgow Gas Department, who will deliver a Paper on "Town Gas for Industrial Heating." The Paper is open to discussion.

Luncheon at the invitation of the Provost, Magistrates, and Town Council of the Burgh of Kirkintilloch will be taken at 1 p.m. in the Miners' Welfare Hall.

Members will re-assemble at 2.45 p.m. in the Town Hall to hear Mr. John Barker, of Nairn, deliver his Paper on "Copper Pipe in Relation to Its Use for Gas Service." The Paper will be followed by a discussion.

In the evening at 7.30 p.m. there will be a Civic Reception by the Town Council of Kirkintilloch in the Town Hall.

On Friday, Sept. 11, there will be an excursion to Inveraray. At 8.50 a.m. the train will leave Glasgow (Central) for Wemyss Bay where the members will embark on the T.S. "Duchess of Argyll." Luncheon and tea will be provided on board. One hour is allowed ashore at Inveraray. The party will return to Glasgow (Central) at 6.58 p.m. Tickets, covering steamer fare, luncheon, and tea, are 12s. 6d. each, and can be obtained from the Secretary, Mr. Archibald Kellock, of Airdrie.

First Prize at the Knaresborough Carnival

This decorated lorry won first prize in the recent Knaresborough Carnival held in aid of the Harrogate and District General Hospital. It was entered by the Harrogate Gas Company. The vehicle is a two-ton forward-control Commer, and the two scenes depict the old and new fashioned methods of cooking. With the old method the husband is unable to eat the food so prepared and the unfortunate wife is reduced to tears; the modern method is typified by an up-to-date gas cooker, a happy wife, and an array of well-cooked food.

New Vertical Retorts for Alloa

Woodall-Duckham Tender Accepted

The Alloa Gas Committee, in view of increased output and the recent purchase of the Alva Gas-Works with an output of fully 40 million cu.ft., have decided to install new carbonizing plant.

The tender of the Woodall-Duckham Company has been accepted for a bench of fourteen 6-ton retorts producing an average daily output of fully 1½ million cu.ft. The installation will be complete with waste-heat boiler and preparation for any future extension of retorts.

Together with other auxiliary plant, the total capital expenditure will amount to about £45,000. The Alva Works will be shut down and gas supply centred in Alloa.

Whitley Bay Park Floodlighted by Gas

The accompanying photograph shows the excellent effect of the gas floodlighting of Whitley Bay Park, which was carried out by the Newcastle-upon-Tyne and Gateshead Gas Company for the Illumination Committee of the Whitley Council.

Benzole Recovery at Glasgow

The plant was designed by Messrs. Newton, Chambers, & Co., Ltd., Thorncliffe, near Sheffield, to deal with a maximum of 14,000,000 cu.ft. of gas per day produced in Woodall-Duckham continuous vertical retorts, and to produce 2½ gallons of benzole per ton of coal carbonized.

New Plant Installed at Provan Gas-Works

The gas scrubber is of the "Thorncliffe" type and has eight washing compartments. The gas leaves and re-enters the 48 in. main through pipes of special design which, in addition to ensuring minimum back pressure, serve to distribute the flow of gas through the entire width of the scrubber. The gas flows through the washer up and down through adjacent washing compartments, the wash oil flowing through the base of the scrubber in counter-current direction to the gas, the level in each compartment being adjusted so that positive flow is ensured. Each of the eight washing compartments contains 188 cu.ft. of 3 in. stoneware Lessing rings, representing a total contact surface of filling of 36,000 sq.ft.

A centrifugal pump serves to draw oil from the bottom of each washing compartment and delivers it into the top of the same compartment, the oil being adequately distributed over the filling material by means of distributors of scientific design. Each of the pumps circulates 8,000 gallons per hour, and this intensive oil re-circulation combined with large contact surface ensures maximum efficiency of benzole extraction.

The eight oil circulators are driven from a countershaft through chains running in oil baths, the countershaft also driving a small pump for delivering benzolized or saturated wash oil to the recovery plant, and another pump of similar size which delivers debenzolized or stripped oil back to the gas scrubber.

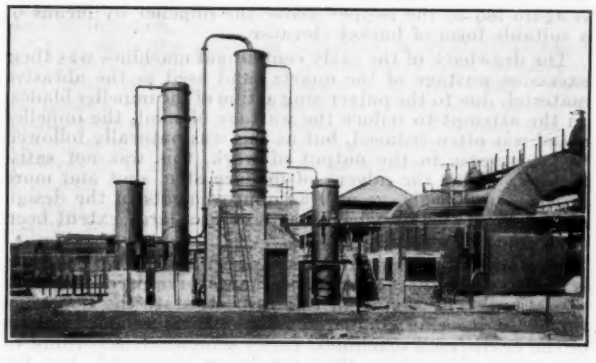
The countershaft can be driven either by 12 b.h.p. steam engine, or alternatively, flame-proof motor, either of which can be used at will by means of a suitable arrangement of clutch. The circulators and prime movers are accommodated in a small building which runs the whole length of the gas scrubber, so that adequate protection from the weather, dust, &c., is afforded. The roof of the building is used as a platform, giving access to the windows in the scrubber side, through which the working of the distributors can be observed.

The scrubber creates very little back pressure, being less than 1 in. w.g. when the scrubber is dealing with 12-14 million cu.ft. of gas per diem. The scrubber is of all welded construction, the mild steel plates being delivered direct from the rolling mills with edges specially prepared for welding, all welding being done at site on the foundations.

Recovery Plant.

The saturated oil from the gas scrubber is pumped continuously into the recovery plant, which is designed to treat a maximum of 2,500 gallons of oil per hour. The benzole contained in the wash oil is removed in this plant by steam distillation at an oil temperature of approximately 275° F. The oil is heated to the required temperature by first being passed through a heat exchanger, and then directly into a heater supplied with steam at 80-100 lb. per sq.in. The hot oil then flows into the still and leaves this vessel via the oil-oil heat exchanger previously mentioned, thereby imparting preheat to the incoming cold saturated oil.

The partially cooled oil then overflows into a receiver from which it is continuously pumped by one of the pumps driven from the scrubber countershaft, through the tubular type oil coolers, the temperature of the oil being reduced to within a few degrees of the temperature of the cooling water. The oil from the coolers passes directly into the gas scrubber via a small tower arranged so that the foul gases from the plant are scrubbed by this oil. The scrubbers are in two parts arranged for series or parallel working and either can be by-passed for cleaning out when necessary.



The still, which the oil enters at approximately 275° F., consists of a column filled with 2 in. stoneware rings below which are six bubbling sections which ensure efficient stripping of the descending oil. A water-cooled dephlegmator or reflux condenser is fitted at the head of the column, and in ascending the column and dephlegmator the heavier hydrocarbons and a large proportion of the steam introduced at the still base are condensed. The condensate descends through the column, meets the up-coming vapours and ensures adequate fractionation.

The vapours leaving the dephlegmator, at a temperature of approximately 184° F., are condensed in a water-cooled condenser, and represent the finished product. The benzole is separated from any water in an automatic separator placed below the condenser. A heavier fraction leaves the base of the column and contains naphthalene absorbed

by the wash oil in the scrubber, and any entrained wash oil which might leave the still head. The naphtha is separated from the condensed water in an automatic separator fixed below the column.

Automatic Control.

The plant is automatically controlled as far as possible, and the only attention required is periodic inspection by a responsible person, daily test of benzole, naphtha, and wash oil, and removal of products from tanks, &c. Thermostatic control maintains a constant temperature of oil entering the still by controlling the steam supply to oil heater, a constant temperature of benzole vapours leaving the dephlegmator by controlling the water supply to this vessel, and a constant temperature of oil leaving the oil coolers by controlling the water supply at this point.

Centralized control is a feature of this plant, all automatic regulators, control valves, stop valves, &c., being inside the house, on the roof of which stands the still, and an elaborate ebonite gauge board accommodates distance thermometers which give temperature readings at all essential points on the plant, pressure gauges which give all steam and water pressures, an oil flow meter, recording steam gauge, recording steam flow meter, and dual recording thermometers.

Storage capacity of 12,000 gallons of benzole, 2,500 gallons of naphtha, and 9,000 gallons of oil is provided, the tanks being of mild steel welded construction and fixed in a large concrete pit in front of the plant.

The steam consumption of the plant is less than 45 lb. per gallon of benzole extracted, allowing for the steam required for the steam engine driving the washer. When the plant is producing the maximum specified quantity of benzole, representing 2,250 gallons per day, the steam consumption will thus be of the order of 4,200 lb. per hour.

In order to maintain the declared calorific value of 470 B.Th.U. per cu.ft., the calorific value of the gas produced has to be increased to approximately 485-490 B.Th.U. per cu.ft. when the maximum quantity of benzole is being extracted.

The Inauguration.

The plant was officially inaugurated by Lord Provost John Stewart, of Glasgow. Bailie Donald McIntosh, Sub-Convener of the Corporation Gas Committee, presided over a large company.

The Lord Provost said: "The process which I am to set in motion to-day represents another forward step in the direction of the completely scientific utilization of coal. It is to achieve a double purpose—firstly to recover benzole from the gas, and secondly to cause an increase in the demand for coal, resulting in an increase in the production of coke and other by-products. We see continual references in the Press to the desirability of producing for our own markets a supply of fuel oil or motor spirit. The Corporation, by installing this plant, is assisting home production so far as benzole is concerned."

Bailie D. McIntosh said he was glad to report that the construction of the plant had proceeded smoothly and satisfactorily. The Gas Committee looked forward to the process yielding the highest results and assisting the Department to meet the abnormal increase in coal costs. The price of gas had been reduced in three successive years and was now 7d. per 1,000 cu.ft. less than in 1933. This reduction was a financial benefit to the gas consumers of £266,000 per annum. He conveyed to the Lord Provost their best thanks for his support.

After inspecting the plant the party were entertained at tea by the Corporation. Thereafter Mr. J. Bishop, for the Contractors, presented the Lord Provost and Bailie McIntosh with silver cigarette cases.

The Lord Provost and Bailie McIntosh briefly replied, and Mr. J. W. McLusky, Engineer and General Manager to the Corporation Gas Department, complimented the Contractors on the expeditious way the work had been done, and thanked his own assistants for their services in connection with the installation.

Sand Blasting

Cleaning Castings for Vitreous Enamelling

An interesting feature of the foundry trade during the last few years has been the adoption of a new type of sand-blasting machine in which the stream of sand or abrasive is directed upon the work by centrifugal force instead of by compressed air. The centrifugal effect is obtained in all such machines by different forms of impellers or vanes rotating at high speeds, very much on the same lines as a high-pressure fan, while the used abrasive is again fed to the hopper above the impeller by means of a suitable form of bucket elevator.

The drawback of the early centrifugal machines was their excessive wastage of the quartz sand used as the abrasive material, due to the pulverizing action of the impeller blades. In the attempt to reduce the wastage of sand, the impeller speed was often reduced, but as this was naturally followed by a decrease in the output of work, this was not satisfactory. With the advent of modern steel shot and more resistant materials, as well as improvements in the design of impellers, this drawback has now to a large extent been overcome.

The most important advantage of centrifugal machines, it is claimed, is the reduction in power required for their operation. The saving in this respect, state the Constructional Engineering Company, Ltd., of Birmingham (makers of the centrifugal machine), varies somewhat, according to the types of machine that are being compared, but for general purposes it may be taken that for a given output per hour and for an equal class of finish the power absorbed by a centrifugal sand blasting machine is between 10% and 20% of that taken by the compressed air type. Economies in maintenance charges are approximately in the same proportions. The only wearing part in a centrifugal machine needing frequent renewal is the impeller blades, which in general cost only a few shillings.

The new centrifugal machines are made both of the usual tumbler and rotary-table types, and the system has been adapted to special machines with conveyor tracks for continuous working. We are informed that loads of castings weighing 16 cwt. can by this system be cleaned in 8 minutes, while 18 cu.ft. loads of forgings and stampings are cleaned in 10 to 15 minutes. In the case of castings for vitreous enamelling, which are so widely produced in the domestic gas appliance trade, these require from 12 to 25 minutes in a machine of the tumbler type, according to the precise class of finish necessary.

Lighting Developments at Stratford-on-Avon

"London" Lamps on Concrete Columns

In view of the forthcoming Annual Conference of the Association of Public Lighting Engineers at Cheltenham from Sept. 7 to 10, Mr. Frederick Shewring, Engineer and Manager of the Stratford-upon-Avon Gas Department, has speeded up the work of improving the public lighting in certain streets of the town. We have noted these improvements in the "JOURNAL" from time to time and, therefore, our readers will be familiar with the progressive policy of the Stratford-upon-Avon Gas Department.

The latest development is the erection of a further seven Sugg's "London" lamps on modernistic concrete columns in Rother Street. This installation follows the erection of six similar lamps in Bridge Street. The greater power of the light sources combined with better mounting height has resulted in a more uniform light distribution. The "London" lamps have 12 No. 2 mantles each and incorporate specially designed reflectors.

Athletic and Social

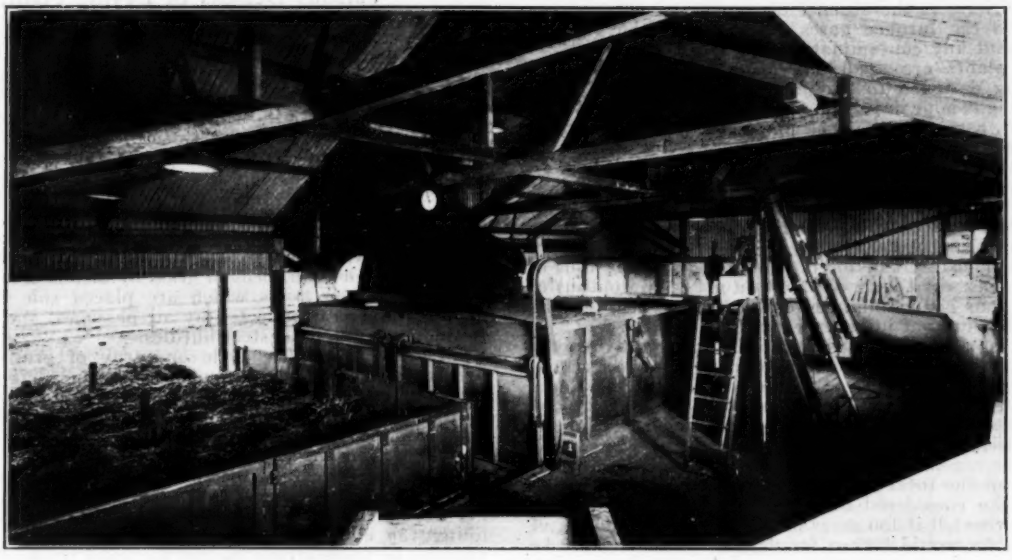
Watford Play "Ascot" at Neasden.

The Soccer season opened last Saturday, Aug. 29, with a match between the Watford and St. Albans Gas Company and Ascot Gas Water Heaters, Ltd., at the latter's ground at Neasden.

The first half opened with lively attacks on the "Ascot" goal by Watford, who finally scored. "Ascot," however, quickly retaliated, and the half closed at one all. The second half, although not so energetic, owing no doubt to the blazing August weather, brought further scores from both sides, "Ascot" scoring another goal and Watford no fewer than three, the match closing at 4-2.

The teams met after the match in the canteen over a friendly cup of tea, Mr. S. C. Knowles, of the Watford Gas Company, deputizing as Vice-Chairman.

Coke-Fired Plant for Grass Drying



An I.C.I. Grass Drier on a Farm in Hertfordshire.

PROGRESS IN AGRICULTURE PROVIDES OUTLETS FOR SMOKELESS FUEL

Reference was made in the Editorial columns of the "JOURNAL" last week to new processes which are being developed by the London and Counties Coke Association with a view to providing further outlets for coke in agriculture. We had the opportunity of inspecting the other day one of the latest developments in this direction—namely, a coke-fired plant for grass or grain drying.

The earlier part of the present summer provided sufficiently unfavourable weather conditions to render the introduction of an automatic plant for the drying of grass or grain a matter of considerable importance to the farmer. The almost continuous rain in many districts throughout the greater part of July seriously interfered with haymaking, and resulted in some cases in heavy losses to farmers by the destruction or poor quality of the hay harvest.

As a direct consequence many farmers are facing a shortage of winter foodstuffs for their beasts which would have been obviated had grass-drying plant been installed. There are obviously great potentialities for the future, and the few particulars of the process which we are able to give here may convince many undertakings that this is a load worth going out for . . . in a climate such as ours.

It may be of interest to refer, at the outset, to the feeding value of dried grass with a view to indicating how advantageous the drying process can be. It is a well-known fact that when grazed on pasture grass in summer, livestock are less prone to ailments and thrive better than when fed in the winter on hay and expensive cattle cake and concentrates.

Young grass properly dried retains in a natural state almost its full feeding value and health-giving qualities, and is able, therefore, during the winter—and without supplement—to fatten stock and supply the requirements of high-yielding cows, keeping them healthier and freer from ailments than when fed upon hay and concentrates. The following table gives a comparison between fresh grass and dried grass made from it:

—	Fresh Grass.	Dried Grass.
Crude protein in D.M., %	17·58	17·83
Fibre in D.M., %	21·95	21·92
Ether extract in D.M., %	2·09	2·79
Digestibility co-efficient of D.M.	74·39	72·34
" " " crude protein	77·62	72·64
" " " fibre	80·43	78·06

The young leafy grass cut and dried in spring and autumn has a higher feeding value than that cut and dried in summer, while the protein and starch equivalent of good quality dried grass compares favourably with the corresponding feeding values of other feeding stuffs. Exceptionally good hay may have a protein equivalent of 6% to 7%, while the highest quality dried grass may have as much as 20%. The mineral content is also important, and dried grass contains about 9%; minerals contained naturally in the food are, of course, of greater value than those added artificially, since in the natural form they are not immediately soluble and only dissolve as required during the process of digestion.

Carotene is the yellowish substance in fresh grass which produces Vitamin "A." It is this which is so valuable in promoting strength and resistance to ailments and disease in animals. Part of the carotene is passed on to the milk, giving that rich colour of summer milk. The full value of the carotene of fresh grass is also present in dried grass, whereas it is absent in the usual winter foodstuffs which give pale milk and butter.

Dried grass would replace material which costs the farmer round about £7 10s. per ton.

We see, therefore, that besides the advantages of being able to cut and artificially dry grass, almost irrespective of weather conditions, it has been found that the grass thus dried retains practically the full feeding value of fresh pasture grass. Grassland has up to the present time been utilized principally for grazing and producing hay for winter feeding. Hay, however, has a low food value, with the result that it has to be supplemented for winter feeding with expensive cattle cake and concentrated food. The low food value of hay is due to bleaching, washing out of soluble salts, and fermentation in the stack, resulting in the loss of essential constituents of protein, minerals, starch, and carotene.

The Drying Plant.

Various types of machine have been designed for the purpose of drying grass. They generally comprise a closed chamber into which the grass is introduced on trays or passed through on endless belts. Adjacent to the drying chamber is a coke-fired furnace or producer, the gases from which are drawn by an induced draught fan through the chambers. Between the furnace and the fan the gases are mixed with cold air drawn through controlled dampers

to reduce the temperature to below 300° F.—which has been found to be a suitable temperature for the drying process.

The fuel consumption varies between 10 and 20 cwt. per ton of grass dried, depending, of course, upon the moisture content of the grass. Coke is essentially the suitable fuel for these driers, as the absence of smoke and volatile constituents in the furnace gases ensures that the grass is dried without any contamination.

Drying plants are made in various sizes, the smaller types being designed to produce about one ton of dried grass per eight-hour day. The maximum potential capacity per annum, assuming that the plant could be kept almost continuously at work from April to October, would be about 450 tons; but the usual maximum output likely to be attained is 200 to 300 tons, assuming in this case that the plant is worked by double shift during times of maximum growth and cutting. Such plants would deal with the produce of 80 to 100 acres.

Larger models are capable of producing 1½ to 1¾ tons of dried grass per eight-hour day, with a maximum output of 250 to 500 tons per annum. Even larger sizes still may be obtained, but are not in general use.

In order to give a rough idea of the capital cost involved in the laying down of grass drying plants, it may be stated that the cost of the types of driers generally available to produce 1 to 1½ tons per eight-hour day would be about £450 to £650 for the bare drying plant alone. The total cost, inclusive of foundations, brickwork, erecting, and roofing over, as well as the compressed air baler, would probably run the total up to round about £1,000.

It has been considered that the cost of a grass drying plant is warranted if 150 acres of grassland is available, of which 75 acres would be cut for drying, producing 170 to 225 tons of dried grass per annum, and 75 acres for grazing and hay-making.

For the Smaller Farms.

The following alternatives are available for smaller farms:

(1) A farmer may install a plant and undertake to dry the products of adjoining farms as well as his own.
(2) A contractor may install a plant and dry grass by contract from farms within a suitable radius.
(3) Farmers or contractors may purchase a portable plant and take it round by contract to dry on the site of the various farms. Such a portable machine is described later.

It is highly desirable to provide as far as possible for continuity of operation of the drying plant; and with this object in view it is necessary for times of dressing and manuring to be arranged so that grass does not come away all at once and beyond the capacity of the plant to deal with it. To obtain the best production results it has been found necessary to provide for working the drying plant continuously during periods of maximum growth and cutting.

As we have said, weather conditions are a cause of anxiety about the hay-making season; but cutting and drying can be carried on almost regardless of the weather, the only drawback to cutting in wet weather being the greater water content which has to be removed from the grass, thereby increasing the cost of drying. The moisture content of young fresh grass usually varies between 70% and 87%, and the cost and time of drying varies approximately with the moisture which has to be evaporated. The spring and autumn grass, having the highest water content, is also the best quality grass, compensating to some extent for the additional cost of drying.

Dried grass is very light, being under 2 lb. per cu.ft. It is therefore convenient to compress it into bales for handling and storage. Baling presses may be either hydraulically or mechanically operated by a belt drive, and the first cost of a baling machine is about £100 to £150. A usual size of bale is 2 ft. 6 in. by 2 ft. by 1 ft. 6 in., weighing 90 to 100 lb. For feeding to pigs or poultry dried grass may be ground to meal and stored in bags.

The Agricultural Research Council's report on "The Preservation of Grass and Other Fodder Crops" gives the estimated cost of producing, cutting, and transporting the grass to the drier as follows:

	£	s.	d.
Growing	1	10	0
Cutting and collecting	0	8	4
Carting to dryer	0	5	9

The average cost of drying is given by various authorities at approximately £2 5s. to £2 15s. per ton, making a total cost of about £4 14s. per ton. When dried grass can conveniently be stacked near the feeding place the cost of baling can be saved; in the loosely packed material, however, there is some loss of carotene in storage. It should preferably be stacked in Dutch barns.

Various Designs of Drying Plant.

There are several different designs of grass drying plant now available, and the one we describe first is that produced as a result of work jointly undertaken by Imperial Chemical Industries, Ltd., and Metropolitan-Vickers Electrical Company, Ltd., which we had the opportunity of inspecting on a farm in Hertfordshire. Here it has given every satisfaction during the few months it has been installed, and has, incidentally, been used for grain drying as well as for grass—thereby indicating a further application of the plant which may well prove of value.

This plant is arranged so that the grass may be dried in two successive stages by a current of hot air drawn upwards through 24-in. beds of grass by means of a fan. The grass is laid on trays which are placed side by side in drying chambers connected by air passages, and is held in position by weighted steel hurdles.

During a 25-minute cycle one tray of grass is partly dried, while the other tray of grass—which has previously been partly dried—is completely dried. At the same time another pair of trays is made ready outside the drying chambers, so that save for short intervals when the trays are exchanged the drying is continuous. When drying is complete, as shown by the thermometer, the trays are removed and a fresh charge prepared. This is done by forking the partly dried grass from one tray to the other, and filling the empty tray with wet grass. The great advantage of transferring the partly dried product from one tray to the other is that it ensures a thorough mixing of the partly dried grass, which leads to the whole being uniformly dried.

Gas coke is being used in a steel producer lined with firebrick. A lid is provided at the top of the producer, through which the coke is charged, the air being drawn in at the front through the firebars. The gases from the producer are burnt at jets controlled by means of a valve, the heated products then being sucked over and under the trays by a fan mounted on top of the drying chamber. The air is heated to 300° F. by mixing with the hot gases from the furnace, finally passing away up a steel chimney. The four doors of the drying chambers are coupled together in pairs, so that one lever operates two doors simultaneously—balance weights making the operation easy. Rubber facings on the doors completely seal the chambers when the doors are closed and the fan in operation, while heat losses are avoided by lagging. It would seem in the case of this particular plant that some little modification of the producer grate might lead to improved operation.

Actual experience with this plant, which is equipped with a compressed air baling machine, has given on a dry day a maximum of 59 bales of 78 lb. each during 10½ hours' working—or a little over 2 tons of dried grass—at a coke consumption of 24 cwt. On a wet day, on the same plant, the throughput fell to 35 bales. During the 10½-hour period the consumption of electricity for the fans, &c., was 180 units. To dry the grass completely an average of 25 minutes is allowed in each tray.

The following figures are given as typical of the two types of "Billingham" drying plant:

—	Large Drier. 80 Sq.Ft. Trays.	Medium Drier. 50 Sq.Ft. Trays.
Wet grass handled in eight hours	6–8 tons	4–5 tons
Dried grass made in eight hours—		
3½ : 1 water ratio	33 cwt.	21 cwt.
Coke used in eight hours	20 ,,	12 ,,

The coke used per ton of water evaporated averages 0·15 to 0·20 ton.

Another type of drier is the Ransomes, Sims, & Jefferies machine, which consists of a steel casing about 30 ft. long, 7 ft. wide, and 3 ft. 6 in. high, mounted on a concrete floor. Inside the casing and extending the full length is a perforated plate about 6 ft. 6 in. above the ground.

Grass is fed from an elevator on to this perforated plate and is drawn slowly along by feed or ladder bars attached to endless chains on either side of the drier. Means are provided for altering the rate of travel as required. A fan supplying hot gases from the coke furnace forces the gases through the grass bed and into a closed-in casing, whence they return by a duct to the furnace to be re-heated and re-circulated through the fan. This drier can also be used for grain, and a small supplementary grate is provided for

this purpose, as the fuel consumption in this process is much less.

A Portable Drier.

As a result of experience with stationary machines, a portable drier, known as the Rowell drier, has been produced in Newcastle. In this case the drying chamber contains a number of endless conveyors one above another. Grass is fed in at the top and is carried along the chamber, discharging at the end on to the next lower conveyor, and so on until it reaches the discharge end of the drier.

The casing of this plant comprises an inner and outer plate with space between, through which gases from a coke-fired furnace, diluted with air to the correct drying temperature, are drawn by a fan. The gases are then passed through radiating tubes which are fixed in the body of the plant between the conveyors, the effect being to subject the grass to additional radiant heat which assists materially in the efficiency of operation.

A further drier—the Petrie and McNaught—comprises a long drying chamber with an endless conveyor. The drying chamber below the conveyor is divided into three sections by two partitions, in each of which there is a fan—both mounted on one shaft. Gases are drawn by these fans from a coke-fired furnace, additional air being drawn in through a controlled damper to reduce the temperature to 300° F. The hot gases are forced by the fans into the two end chambers of the drier and up through the grass bed on the conveyor, part of the gases being drawn down through the grass bed into the middle chamber by the suction of the fans, and re-circulated. The remainder pass through to the exit end of the machine and discharge to atmosphere. It is claimed that this method of drying results in high efficiency, and that the hot gases passing both up and down through the grass tend to produce an evenly dried product.

From the foregoing brief particulars of the process it may be concluded that if the artificial drying of grass is considered in conjunction with the research work which has been carried out during recent times with the object of improving the quality and productivity of grassland, the results may be far-reaching.

We are indebted to the London and Counties Coke Association for the foregoing particulars in regard to the drying process. In England and Wales we have some five million acres of grassland, producing a little over 1 ton of hay per acre per annum. If but one-tenth of the grass from this pasture land were artificially dried to produce a material of high feeding value for livestock it would necessitate the use of no less than 300,000 tons of smokeless coke for the purpose. This figure alone is sufficient to show the vast potential market which lies open to the efforts of the energetic coke salesman.

A Field for Gas Also.

That the process of grass-drying is not solely confined to rural areas is indicated by Mr. J. W. B. Holm, of the Institute of Agriculture, Usk, in a letter which appeared in a recent issue of the *Western Mail*.

In this the correspondent suggested that in the light of recent research and experience, city councils, aerodrome authorities, playing fields associations, sports clubs, and such bodies should consider the economic conversion of grass cuttings into a valuable feeding product. At the present time thousands of acres of lawns, parks, and playing pitches are mown periodically at some cost, and the product dumped in some remote refuse heap to ferment and at best supply a little organic matter for future use. Thus the keeping of such grass in good condition entails labour and expense towards one end only. Why not turn this expensively procured " waste product " into nutritive and preserved cattle food for winter use and, what is of supreme importance, into a commodity which will help to pay for the labour and other costs now incurred in its disposal?

Every acre of lawn or playing field would probably produce one-and-a-half to two tons of dried grass per annum, so that within the boundaries of our large towns, with their extensive playing fields and open spaces, upwards of a hundred tons of dried grass might be made available to fodder merchants or farmers each year. And at the present prices of cattle foods this amount of dried grass would be worth approximately £500—a sum which would become available to meet salaries and wages of parks staffs and greenkeepers.

Mr. Holm estimates the total costs of grass drying at £4 per ton, including field work, carting, and fertilizers, which approximate 30s. per ton of the product. Even authorities controlling small areas would find little difficulty in operating a drier to capacity, as many neighbouring farmers would doubtless gladly make use of it who could not themselves afford the capital outlay of a drying plant.

The foregoing factors show up the grass-drying process in another light and bring it within the orbit of gas as distinct from coke. For, whereas coke is the obvious fuel for the more remote districts, where it would be impracticable or uneconomic to extend a gas main, in the urban areas there might also be a definite field for the application of gas.

Gas Undertakings' Results

Cork.

The Directors' report to the shareholders of the Cork Gas Consumers' Company for the half-year to June 30, 1936, states that when compared with the corresponding period of last year the accounts show a satisfactory increase in the rental account, although gas was sold during the half-year at reduced prices. There has also been a substantial increase in the return from residuals, principally due to the greater demand for coke and tar products. After placing £2,887 to the credit of the depreciation fund, and £1,000 to the credit of the insurance fund, the balance of profit and loss is £4,532, with which it is proposed to pay the usual dividend at the rate of 8% per annum. Mr. J. McNicholl, the Engineer, reports that the repairs to the retort settings referred to in the previous report are now in hand and the work on No. I. coke conveyor has been completed.

Greenock.

The Greenock Corporation Gas Department report that for 1935-36 the gross revenue from gas, residuals, &c., was £98,992, an increase of £4,950 over the previous year. The gross expenditure for manufacture, &c., was £83,427, an increase of £7,997 over the previous year. The balance of revenue over expenditure was £15,565. Standing charges amounted to £13,424. A sum of £2,000 was transferred to reserve, leaving a credit balance of £141, which, added to the credit in net revenue account, enables a balance of £4,765 to be carried forward in the current year's account. The average cost of coal per ton last year was 18s. 3d., being 4s. 4d. per ton more than in 1914. A further increase of 2s. per ton must be met in the current year, but no advance in the price of gas is to be made this year. The average price of gas at 2s. 2·16d. per 1,000 cu.ft. (6·38d. per therm) is lower by 2·8d. per 1,000 than in 1914. The quantity of gas made at 749,897,000 cu.ft. shows an increase of 42,302,000 cu.ft. (6%) over the previous year, and is fully 80% more than the year's make in 1914. One half of the carbonizing plant at Inchgreen has been entirely redesigned and rebuilt to give a gas-making capacity some 30% over that of the old plant; the latest scientific developments in carbonizing practice have also been taken advantage of in the redesigned plant, and improved working results are thus anticipated. This reconstruction scheme included the provision of a new waste-heat boiler, feed pumps, feed-water heater, &c., the renewal of coal and coke bunkers, gas lighting, superheated steam and water services, and coke skips, turntables, and rails. On the distribution side of the Undertaking, 7,443 yds. of mains have been laid, bringing the total length of gas main in Greenock up to 94·19 miles. The first section of a new 18 in. trunk main from Inchgreen to the east end of the town has been laid, and the material is on hand to complete this work, together with the provision of new mains in the Central Area where an extensive slum clearance scheme is being carried out.

Oswaldtwistle.

The annual report of the Engineer and Manager of the Oswaldtwistle U.D.C. Gas Department, Mr. D. J. Colvin, for the year ended March 31, 1936, states that the total quantity of gas sent out amounted to 112,927,000 cu.ft., a decrease of 249,000 cu.ft. against the previous year. Gas sold increased by 1,398,750 cu.ft., or 1·3%. Ordinary meters show a decrease of 1,347,700 cu.ft.; prepayment meters a decrease of 29,800 cu.ft.; but gas used for industrial purposes has increased by 2,714,000 cu.ft. The net income from residuals, after deducting cost of handling, carting, &c., was £5,254, as against £5,388 last year, a decrease of £134. The year has been marked by a very large increase in the sale of appliances, representing an increase of 103% over last year, and constituting a record for the Department, the average revenue per consumer being 22s. 3½d. The number of street lamps in the district is 450. Seven new lamps were fixed during the year. The revenue expenditure and income during the year were £19,670 and £23,387, leaving a gross profit of £3,717, equal to 15·6% of the outstanding debt, as compared with a gross profit of £3,874 last year. Interest on loans, sinking fund instalments, and income-tax absorb £3,566, leaving a net profit of £536, as compared with £334 last year.

THE ACTION OF Gases and Vapours on Refractory Materials

By
A. T. GREEN
and
F. H. CLEWS

From a Paper before the Chemical Engineering Congress of the World Power Conference

It is now recognized that many of the gases and vapours with which the refractory materials come in contact in carbonization can have detrimental effects on the durability of these products. It is, nevertheless, difficult to assess the reduction in durability consequent upon any of these actions.

In the following discussion the actions and the conditions governing them are considered in the light of recent investigations.

Carbon Monoxide.

B. Osann[1] was probably the first to report the disintegration of certain types of clay refractory materials by the action of carbon monoxide at between 450° and 500° C. Since then, the reaction has been investigated by various workers.[2] Experiments, in which one of the present authors[3] has been associated, have largely confirmed their findings, and extended them in certain directions. In these investigations a number of specimens from commercial products and also synthetic preparations compounded from an "iron"-free clay mixed with different types of ferruginous material have been examined for the action of carbon monoxide at 420° C. for periods up to 200 hours. The ferruginous materials used were hæmatite, magnetite, pyrites, and an iron-oxide clay fusion. The effects of carbon monoxide on these materials were studied both when incorporated to the extent of 2 and 5% in the iron-free clay and fired, and also after different heat treatments without admixture.

The chief conclusions may be summarized:

(1) The cause of the disintegration is the deposition of carbon due to the reaction $2CO \rightarrow CO_2 + C$, the carbon being deposited round "iron spots." In some cases a few hours only are required to cause breakdown.

(2) A particular type of "iron spot" is most effective in causing disintegration. This appears as blue-black crystals under the microscope, and is denser than bromoform. Free ferric oxide and magnetic iron oxide are the probable nuclei for carbon deposition.

(3) Conditions which tend to cause chemical combination of the "iron" oxide with the materials of the clay, such as high temperature or a reducing atmosphere, decrease the tendency of the product to disintegration.

(4) The total content of the "iron" in a brick is no index of its liability to disintegration by carbon monoxide.

(5) Dilution of the carbon monoxide with nitrogen increases the time required to produce disintegration without inhibiting it.

Out of eleven commercial types of firebrick tested in the above experiments only three completely resisted disintegration during 200 hours. It is, therefore, not surprising to find instances where failure of refractory materials can be fairly definitely attributed to the action of carbon monoxide. It is apparent that in gas producers the requisite conditions of temperature and atmosphere can occur in certain positions in the lining towards the shell. So also in regenerators; some portions of the chequer work are in contact with gases at 350° to 600° C. which may contain significant amounts of carbon monoxide. Again, an instance of crumbling[4] has been reported in the bricks lining a producer gas main. These bricks, tested at 500° C. in a slow stream of producer gas containing 28% carbon monoxide, blackened and swelled after 200 hours' exposure and commenced to disintegrate after 300 hours. After reburning at 1,300° C. the tendency to disintegrate was considerably reduced.

Hydrocarbons.

The action of various hydrocarbons on firebrick materials is similar in certain respects to that of carbon monoxide. The reactions are complex, but frequently carbon is formed as one of the products.

B. C. Ruprecht, R. H. H. Pierce, and F. H. Harvey[5] have investigated the action of natural gas and of hydrogen on various refractories. Whereas hydrogen was without disruptive action, natural gas containing 80-85% methane and 15-20% ethane caused the disintegration of some firebricks at 640° C. Previous cracking of the natural gas at temperatures from 750° to 1,000° C. accentuated the power to cause disruption which occurred at a lower range of temperature. Experiments by E. Rowden and A. T. Green[6] have indicated that pure methane at 800° C. can cause complete disintegration of some firebricks in 67 hours. In like manner, town gas has been found to cause the disintegration of some firebricks at 900° C. in 72 hours. The iron spots appear to be the foci of the reaction, and carbon is deposited at these points. A period of induction seems to be required in which some catalytic agent, possibly derived from the "iron" nuclei, is apparently brought into active condition. The silica bricks which have been tested do not show obvious disintegration under these conditions. Ruprecht, Pierce, and Harvey state that firebricks fired to cone 14 (1,410° C.) do not show the same disruptive tendency in presence of hydrocarbons. This is in keeping with observations on the analogous action of carbon monoxide.

It thus seems reasonable to conclude that the disintegration which is fairly common in the top courses of the chequer work in the carburettors of carburetted water-gas plants may be attributed, in part at all events, to reactions similar to the above. Even if the liquid hydrocarbons used in the carburetting process do not directly give growths of carbon round the "iron" nuclei, the evidence indicates that the simpler gaseous hydrocarbons which result from the cracking of the former will be able to do so.

The firebrick courses at the top of vertical retorts suggest themselves as a region where this action might occur. Occasionally it is found that the brickwork in this zone suffers appreciable disintegration, but sometimes it appears to be immune. It should be realized, however, that the carbonaceous deposit within the bricks, which is the main evidence of such action, is likely to be burnt off under industrial conditions before they could be examined. Although the iron residue left on oxidation of the carbon has been observed in the cracks of brickwork, it is very finely divided and liable to be lost or escape notice. Moreover, the reaction has not received much attention until recently, and its possible occurrence in gas retort working has not been given adequate consideration. Recently, one of the authors obtained evidence in the study of the brickwork of a coke oven that the firebrick doors of this installation were deteriorating in consequence of the action of hydrocarbon gases.

Horizontal fireclay retorts might also be expected to give evidence of disintegration due to the action of hydrocarbons. This has not been conclusively demonstrated. It is possible here that intermittent working, involving periodic discharge of the coke and filling with coal, will allow oxidizing actions to occur which will counteract the reactions occurring during the period of induction referred to above.

Volatile Iron Compounds.

Evidence for the attack of gas-works refractories by iron compounds is frequently to be observed in the reddish or purple discolorations of the surface of the silica brickwork of retorts which has not been protected by a coating of scurf. Thus, in horizontal retorts the surface floor tiles, on which scurf does not tend to accumulate appreciably, may be obviously iron-stained. Its appearance and the chemical analysis suggest that the action is largely one of penetration by volatile iron compounds rather than by a liquid slag rich in iron. The accumulation of iron compounds in preference to the other constituents of the coal ash suggests volatile transfer of the iron. The considerable depth of penetration is worthy of note.

It has been suggested by Mr. A. Edwards that the volatile iron compound involved may be the chloride, formed, possibly, by direct interaction of hydrochloric acid on oxides or other compounds of iron. The hydrochloric acid is probably derived from traces of chlorides in the coal. In view of the relative stability of alkali chlorides to hydrogen and steam below 800° C., it is more than possible that

oxides of sulphur have been involved in the liberation of the hydrochloric acid. However, no soluble chloride is detected in the affected brickwork, so that the halogen is probably returned to the gaseous system again.

There is evidence of a similar character that in gas producers also similar transfer of "iron" occurs, causing some of the attack noticed on producer linings.

Other evidence of the presence of volatile iron compounds in carbonizing installations is to be found in the appearance (confirmed by analysis) of the flakes of silica or siliceous brickwork which tend to separate from the surfaces of vertical retorts in the region from 6 to 12 ft. from the top. These flakes are frequently iron-stained, particularly on the surfaces at which fracture occurs. It would appear that some form of volatile iron has penetrated into incipient cracks beneath the surface of the brickwork before actual separation has taken place. The effect of this iron impregnation in weakening the surface structure should be borne in mind in any consideration of the cause of the phenomenon of flaking.

Alkali Salt Vapours.

Soda and potash are frequently important constituents in the ash of coals, and some types of coal may contain appreciable amounts of sodium chloride and sometimes sulphate. The carbonization of such coals is an operation which is likely to exhibit evidence of the attack of the refractories by volatile alkali compounds.

A good illustration of the transfer of alkalis from the coal of the charge to the refractory materials is given by the following analysis of an incrustation which had formed in a vertical retort.[7] It had been operating, it is true, on an unusual type of lignite or brown coal, the ash of which contained SiO_2, 4·1%; Fe_2O_3, 37·7%; Al_2O_3, 7·9%; CaO, 10·5%; MgO, 11·8%; SO_3, 20·3%; K_2O and Na_2O, 7·7%. Samples of this incrustation to a depth of $\frac{1}{8}$ in. were taken from the retort face at intervals of about 2 ft. 6 in., measuring from the bottom. Computations of the amount and composition of the extraneous slagging matter added to the surface were made. The results are reported in Table I. as percentages of the various constituents added to the original brick. The retort was constructed of highly siliceous brick.

TABLE I.

—	Distance from Bottom of Retort. Ft.	Extraneous Matter in Retort Surface. %	Computed Composition of Extraneous Matter.				
			Al_2O_3.	Fe_2O_3.	CaO.	MgO.	$Na_2O + K_2O$.
1	4	8·46	..	1·43	1·19	1·29	4·57
2	6½	8·73	2·52	1·04	0·96	0·96	3·25
3	9	6·67	1·84	1·15	0·50	0·55	2·63
4	11½	6·41	1·70	0·58	0·29	0·49	3·35
5	14	6·59	0·78	0·61	0·24	0·22	4·74
6	16	4·59	0·55	0·40	0·07	0·50	3·07
7	18	5·10	0·37	0·44	0·31	0·24	3·74

The table shows the larger accumulation of slagging material in the lower portion of the retort, which is usual in vertical retorts. At the same time it should be pointed out that alkalis form over half the added matter, although in coal ash they are not predominant constituents. They are also more uniformly distributed throughout the length of the retort. It is probable, therefore, that this transfer of alkalis is due to attack by a volatile compound.

In an investigation[8] into the possible causes of flaking in vertical gas retorts chemical analyses have been made of specimens of such flakes. Both silica and siliceous materials have been examined. A table of the total percentage of potash and soda of these samples is given in Table II.

TABLE II.

Type of Material.	$K_2O + Na_2O$.
	%
Siliceous brick flake outside	2·40
,, ,, ,, inside	1·70
,, ,, unused	0·4–0·9
Silica brick flakes (average of four)	0·73
,, ,, unused	0·52
Silica brick flake A	0·90
,, ,, ,, C	0·60
,, ,, ,, G	0·86
,, ,, unused	0·3–0·5
Silica brick flake B	0·78
,, ,, ,, H	0·50
,, ,, ,, J	0·54
,, ,, unused	0·3–0·5
Siliceous brick flake D	3·10
,, ,, ,, E	0·78
,, ,, ,, F	2·60
,, ,, ,, I	0·88
,, ,, unused	0·7–0·9

It seems that the presence of alkali is not essential to the production of flaking, although it may well have some effect in weakening the surface of the refractory. This may occur either through chemical combination and the formation of substances in localized regions of different physical properties from the body of the brick, or by accelerating the conversion of the quartz in the siliceous product.

This investigation also tends to indicate that the siliceous clay-bonded material will absorb and retain alkalis to a higher degree than the lime-bonded silica material. The flakes A to J, for instance, refer to two types of silica brick and one type of siliceous brick, and all have been subjected to similar conditions as regards the coal used in the retorts. Yet, the two instances of fairly high alkali content are to be found with the siliceous product.

Some recent laboratory experiments[9] may have a bearing on this question in confirming the works' data. For example, it has been found that when different refractories are impregnated with a strong solution of potash or of soda, dried, heated to 1,000° C., and then suspended at this temperature in a cavity composed of the same refractory, the rates of loss of alkali are greater with the silica than the siliceous material, and this in turn is greater than with a fireclay product. Values are quoted in Table III. The rate of loss of potash is greater than that of soda, but the same differences between the different classes of product are indicated.

TABLE III.

Volatilization from K_2O.
Impregnated Materials at 1,000° C.

Silica D.		Siliceous F.		Firebrick E.	
Hours.	% K_2O.	Hours.	% K_2O.	Hours.	% K_2O.
0	2·79	0	3·22	0	3·87
3·5	2·35	6·0	2·82	4·75	3·80
5·5	2·18	9·0	2·70	9·75	3·63
12·0	1·92	12·0	2·65	12·25	3·60
14·5	1·82	15·0	2·60	19·5	3·55
21·0	1·68	21·0	2·54	25·25	3·53
27·5	1·55	26·5	2·49	31·0	3·50
34·5	1·45	34·75	2·45	37·25	3·49
41·0	1·36	..	..	43·0	3·49

Volatilization from Na_2O.
Impregnated Materials at 1,000° C.

Silica D.		Siliceous F.		Firebrick E.	
Hours.	% Na_2O.	Hours.	% Na_2O.	Hours	% Na_2O.
0	4·33	0	2·37	0	3·86
3·25	4·15	2·5	2·32	2·25	3·82
6·25	4·07	5·5	2·30	4·75	3·81
11·25	3·97	10·75	2·27	10·0	3·78
19·0	3·86	16·5	2·25	15·75	3·76
24·0	3·79	21·75	2·24	19·75	3·75
31·25	3·71	27·5	2·23	25·5	3·73
39·25	3·66	33·0	2·22	31·5	3·75
45·0	3·61	..	..	..	..

Again, when small, thin specimens of silica, siliceous, and firebrick materials are exposed to the vapour of molten potassium chloride at 1,000° C. in dry air, the greatest rate of combination occurs with the fireclay, least with the silica, and an intermediate amount with the siliceous products. The results in Table IV. may be taken as typical.

TABLE IV.

Material.	Length of Exposure. Hours.	Total Increase in Weight. %	Increase Due to KCl. %	Combined K_2O. %
Fireclay	118·5	12·17	0·21	11·96
Siliceous	118·5	6·98	0·17	6·81
Silica	118·5	4·47	0·17	4·30

From this it appears that alkali vapour attack would tend to be more localized on the surface of the refractory with the siliceous retort material than the silica. With the latter it would tend to become more uniform either by

distillation further into the brickwork or even back into the gas streams in the retort, should the vapour pressure of the alkali decrease. If alkali contamination were at the root of the flaking phenomena it would thus be more prone to occur in the siliceous retorts. It cannot be said that this is so. The part played by alkali is thus more likely to be a subsidiary one. It possibly causes greater weakness in the surface layers.

The data in Table IV. are also in keeping with the general observation[10] that coke ovens constructed of silica material are more durable than siliceous or fireclay, when salty coals are being carbonized.

They also accord with observations by W. J. Rees[11] on the action of sodium chloride on silica and clay refractories. It has been suggested that the alkali silicates formed with silica materials are fusible at the temperature of coke oven working and form a protective viscous coating, whereas the alkali alumino-silicates formed with firebrick materials are not liquid, and thus allow the action to proceed well into the brickwork. Nevertheless, the reaction has altered the character of the firebrick walls and rendered them susceptible to the abrasion occurring during charging and ramming.

Water Vapour.

Although water vapour is commonly in contact with refractory materials at high temperatures in many types of furnace and other installations, yet comparatively little investigation of its effects has been made. A. E. J. Vickers and L. S. Theobald[12] have observed the considerable alteration produced by an atmosphere of steam in lowering the refractoriness of a Seger cone mixture blended with different amounts of Thivier's earth as a source of iron oxide. When over 1% Fe_2O_3 was present the reduction in refractoriness was more than when hydrogen itself was used. Similar results were obtained when ferric oxide, added in the form of pure oxide, was present in a fireclay mix. The reduction in refractoriness in steam (as compared to air) was approximately proportional to the content of Fe_2O_3. The range of temperature covered by these experiments was 1,450° to 1,200° C.

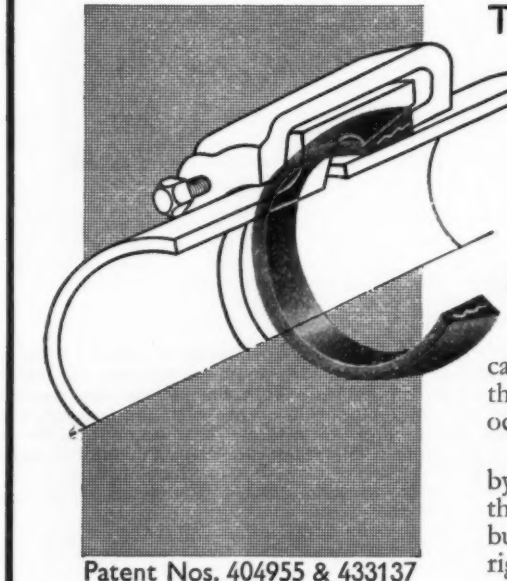
On the other hand, H. T. S. Swallow,[13] using firebricks of different types with appreciable contents of iron, was unable to detect any measurable reduction of refractoriness in an atmosphere of steam. C. W. Parmelee and A. E. R. Westman[14] also found that the effect on the transverse strength of heating three types of firebrick for three hours at 1,100° C. in steam was insignificant. The change in refractoriness was not determined.

The effect of steam on silica bricks at 1,500° to 1,600° has been studied by A. E. Dodd.[15] Specimens 12 in. long, of slightly elliptical cross section, were suspended in a Hirsch furnace into which steam was admitted at the bottom. After a period varying from 20 to 240 minutes all the nine specimens broke in two, under their own weight. In some cases obvious fusion had occurred, in others a kind of rotting caused the fracture. The failure occurred in the zone of the brick exposed to the highest temperature. In discussing the cause of these phenomena, Dodd points out the possibility of the following reactions in decreasing the viscosity of the matrix of the bricks: (*a*) hydrolysis of Fe_3O_4 to $Fe(OH)_2$ and $Fe(OH)_3$ followed by combination of $Fe(OH)_2$ with silica; (*b*) solution of water vapour in, or chemical combination with, the silicates of the matrix. Volatilization of silica and its redeposition may account for the "rotting" effect. He also suggests these reactions as a possible explanation for the effects of steam reported by Vickers.

The failure of a steel furnace roof where undiluted coke oven gas, rich in hydrogen, had been used as fuel, has been attributed by Dodd largely to the action of steam produced by the combustion of the hydrogen. Whether effects of a like nature may be observed in carbonizing installations is a matter of speculation. It is difficult not to believe that similar actions, probably considerably reduced in intensity, take place in the hottest parts of the combustion chambers of silica gas retorts, either horizontal or vertical. The rapid development of "holing" which follows leakage of gas *via* defective joints from retorts into the combustion chambers may also be dependent on this reaction, for the combustion of the gas will generate steam and a high local temperature. However, the range of temperature over which the reaction occurs has not been explored up to the present.

Hydrochloric Acid and Chlorine.

Some experiments reported by S. M. Phelps[16] are quoted in Table V., because they have a bearing on the presence of volatile iron and alkali metal compounds in carbonizing installations. In these experiments finely ground samples



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of two types of clay product were heated in a silica tube in a stream of chlorine or hydrochloric acid gas and the volatile products condensed and analyzed. The various percentages under the headings HCl and Cl_2 refer to the proportion of the constituent present in the original clay which has been volatilized.

TABLE V.

—	Proportion of Clay Constituents Distilled at 1,175° C. in 90 Mins.					
	Calcined Plastic Clay.			High Alumina Refractory.		
	Original Content. %	HCl.	Cl_2.	Original Content. %	HCl.	Cl_2.
Al_2O_3	27·54	7·0	16·3	70·57	1·8	1·1
Fe_2O_3	2·24	69·6	95·9	—0·79	89·8	27·8
TiO_2	1·53	51·0	47·7	3·37	47·7	45·4
CaO	0·27	..	..	0·32	..	..
MgO	0·73	72·6	42·4	0·51	41·0	19·6
$K_2O + Na_2O$	3·75	80·2	100 0	3·36	97·9	69·9

It will be seen that most of the clay constituents are volatile to some extent in a stream of chlorine or hydrochloric acid but that the iron oxide and the alkalis are the most volatile. This agrees with the observations on volatile iron and alkali attack in gas retorts. Local concentrations of chlorine or hydrochloric acid derived from salty coals may thus suffice to remove alkalis or "iron" from coal ash or refractory and to deposit it in another location where the conditions may permit of the reverse reactions.

It also appears likely that the removal by distillation of "iron" or alkali from a fired clay product will reduce the mechanical strength since these elements are usually an essential part of the matrix. Phelps has indeed reported definite decreases in crushing strength on firing different clay bricks in chlorine at 950° C. for 72 hours.

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(To be continued.)

Watford Industrial Purposes Tariff

An attractive folder drawing attention to the advantages of gas as an industrial fuel, and setting forth the Watford and St. Albans Gas Company's block scale of charges for gas for industrial purposes, has recently been prepared by the Company.

On the first three pages of the folder are illustrations of typical gas installations, while the back page is overprinted with the special rates for each district. Every encouragement is given to industrialists to avail themselves of the services and facilities provided by the Company's Industrial Department and the attractive tariff offered. The following rates apply to the Watford area:

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Next 2,500 ,, ,, ,,	7·5
,, 5,000 ,, ,, ,,	7·0
,, 5,000 ,, ,, ,,	6·5
,, 10,000 ,, ,, ,,	6·0
,, 25,000 ,, ,, ,,	5·5
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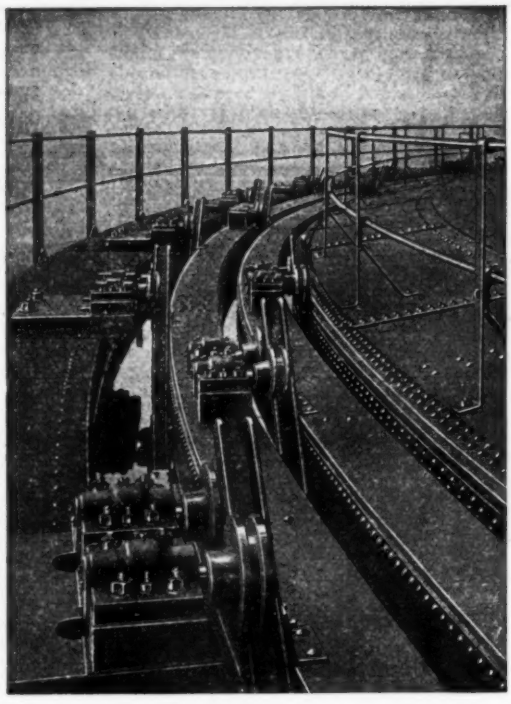

AS APPLIED TO A 2,000,000 C.FT. GASHOLDER AT SWANSEA.

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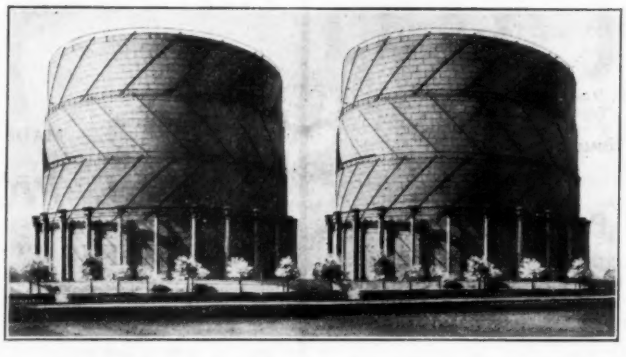

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Gas Markets and Manufactures

Stock Market Report

(For Stock and Share Lists, see later pages)

There was a quiet opening to the new Account last week, but as the week progressed and more confidence was shown in the international political situation, conditions became more active. A cheerful tone developed in nearly all departments, particularly in the gilt-edged section, and British Funds closed fractionally higher. Home Rails also improved again, while leading industrials continued popular and recorded a fair number of gains, though in many instances profit-taking took its toll of the increased prices. Another feature was a revival of interest in oil shares, Mexican Eagles having now reached their highest price for many years. Taking it all round, the holiday month has been exceptionally active, which should turn out a good omen for the autumn and winter periods.

The Gas market on the whole was fairly quiet and there were no special features. Prices were steady, and with the exception of *ex* div. markings, only a few quotations were changed. In the Official List an enquiry for Maidstone Ordinary, of which there is now very little available, led to a sharp rise of 10 points to 190-200, and Bournemouth 6% preference and Portsmouth 5% maximum stocks both improved 2 points. At the Provincial Exchanges the only alteration of note was a rise of 1½d. to 27s.-27s. 9d. in Newcastle and Gateshead Consolidated, while in the Supplementary List S. Midland Gas Corporation, Ltd., rose 2s. to 22s.-24s.

Current Sales of Gas Products

The London Market for Tar Products.

Aug. 31.

The prices of tar products in general remain unchanged:
Pitch is nominal at 35s. to 36s. per ton f.o.b.
Creosote, about 5½d. per gallon.
Refined tar, 3¾d.
Pure toluole, about 2s. 4d.; pure benzole, 1s. 7d. to 1s. 8d.; 95/160 solvent naphtha, about 1s. 7d.; and 90/160 pyridine, about 5s. to 5s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Aug. 31.

The average prices of gas-works products during the week were: Gas-works tar, 19s. 3d. to 24s. 3d. Pitch—East Coast, 33s. to 35s. 6d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 33s. to 35s. 6d.* Toluole, naked, North, 1s. 10½d. to 1s. 11d. Coal-tar crude naphtha, in bulk, North, 8d. to 8¼d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 4¼d. Heavy naphtha, North, 1s. 1½d. to 1s. 2½d. Creosote, *ex* works, in bulk, North, liquid and salty, 4¾d. to 5d.; low gravity, 4½d. to 4¾d. Heavy oils, in bulk, North, 5d. to 5¼d. Carbolic acid 60's, 2s. 4d. to 2s. 6d. Naphthalene, £21 to £23. Salts, 95s. to 100s., bags included. Anthracene "A" quality, 3d. to 3½d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Aug.* 29.

There are still innumerable enquiries for lighter fractions, but supplies are particularly scarce and little new business can be arranged. The heavy products are still rather dull.

Crude gas-works tar.—The actual value is 34s. to 35s. per ton *ex* works in bulk.

Pitch.—Quotations are unchanged at 32s. 6d. to 35s. per ton f.o.b. Glasgow for export, and 32s. 6d. per ton *ex* works in bulk for home trade.

Refined tar.—There is a moderate business being conducted at 3d. to 3¼d. per gallon f.o.r. for export and 3¾d. to 4d. per gallon *ex* works in buyers' packages for home trade.

Creosote oil.—Demand for this product is not above average, but prices are fairly steady, as follows: Specification oil, 4¾d. to 5d. per gallon; low gravity, 5d. to 5¼d. per gallon; neutral oil, 4¾d. to 5d. per gallon; all *ex* works in bulk.

Cresylic acid.—Supplies are particularly scarce, and, with continued heavy demand, prices are firm as under: Pale, 97/99%, 2s. 3d. to 2s. 5d. per gallon; dark, 97/99%, 2s. to 2s. 2d. per gallon; pale, 99/100%, 2s. 9d. to 3s. per gallon; all *ex* works in buyers' packages.

Crude naphtha.—Production is small and available supplies command 5½d. to 6d. per gallon *ex* works in bulk, according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 5d. to 1s. 6d. per gallon and 90/190 heavy naphtha is 1s. to 1s. 1d. per gallon.

Motor benzole continues to be valued at 1s. 3½d. to 1s. 4d. per gallon.

Pyridines.—90/160 grade is 4s. 6d. to 5s. per gallon, and 90/140 grade 5s. to 5s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole	0	8½	to	0	9	per gallon at works
Motor "	1	2	"	1	2½	" " "
90% "	1	3	"	1	3½	" " "
Pure "	1	7	"	1	7½	" " "

Contracts Advertised To-Day

Controllers (Clockwork).

Shipley Gas Department. [p. 544.]

Electrical Detarring Plant.

City of Plymouth Gas Department. [p. 544.]

Lanterns (Street).

Shipley Gas Department. [p. 544.]

Trade Notes

Thermal Appliances, Ltd.

This firm has introduced an instantaneous gas water heater (Type 352-B.T.) incorporating automatic control of the outflow water temperature. The appliance embodies gas governor, water governor, thermostat, and slow action device.

"Benham" Gas Cooking Apparatus.

The abridged new season's list of Messrs. Benham & Sons, Ltd., 66, Wigmore Street, W.1, is a very attractive publication. The covers are gold overprinted with black and red and the contents are liberally illustrated. The new pattern "Solid-top" range, which has been developed from the "Solid-top" range originally introduced by Messrs. Benham in 1927 to meet the demand for a gas stove which would provide the same cooking facilities as coal but without the corresponding disadvantages, is detailed in the new list. Other appliances described include roasting, pastry, and general purpose ovens, high-level ranges, boiling tables or hot plates, steamers, boiling pans, fish fryers, &c. A list of some well-known users of "Benham" gas cooking apparatus is appended.

Overseas Opportunities

Iraq (Bagdad).

The Commercial Secretary to H.M. Embassy at Bagdad reports that the Bagdad District Water Board is calling for tenders, to be presented in Bagdad by Sept. 29, 1936, for the supply and delivery of copper tubes and fittings. (Ref. T.Y. 30700.)

Straits Settlements.

H.M. Trade Commissioner at Singapore reports by air mail that the Singapore Municipal Water Department is calling for tenders for the supply and delivery of quantities of galvanized wrought-iron unsocketed tubes of nominal bores ¼ in. to 2½ in. to be presented in London or Singapore by Oct. 26, 1936. (Ref. T.Y. 30682.)

Singapore.

H.M. Trade Commissioner at Singapore reports that the Singapore Municipality is calling for tenders for the supply and delivery of malleable iron pipe fittings and miscellaneous special fittings, including: Bends, elbows, tees, crosses, reducing sockets and crosses, hexagon nipples, caps, plugs, backnuts, pipe straps, brackets, couplings, hooks, bushes, and fibre washers. Tenders, endorsed "Tender for Supply of Malleable Iron Pipe Fittings and Miscellaneous Special Fittings," should be addressed either to the Municipal Secretary, Municipality, Singapore, S.S., by whom they will be received up to 4 p.m. on Nov. 9, 1936, or to The Inspecting Engineers, Messrs. Peirce & Williams, 1, Victoria Street, S.W. 1, by whom they will be received up to 10 a.m. on the same date. (Ref. T. 30689.)

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THE WEST SYSTEMS

OF MODERN GAS AND COKE PRODUCTION

The West organization has co-operated with progressive Gas Undertakings in 24 countries in their schemes of works modernization, plant renewal, and extension.

- GLOVER-WEST VERTICAL RETORTS
- WESTVERTICAL CARBONIZING CHAMBERS
- BREEZE-FIRING PRODUCER EQUIPMENT
- WASTE-HEAT RECOVERY PLANTS
- THE WEST LIP-BUCKET CONVEYOR WITH AUTOMATIC LUBRICATION
- COKE GRADING AND PREPARATION UNITS

Contracts placed with West's Gas Improvement Company, Ltd., during the present year have included carbonizing plant installations for the Gas Undertakings of *Altrincham, *Bilston, *Carlisle, *Dudley, *Worcester, and *Yeadon, in England; *Dumbarton, *Grangemouth, and Kelso, in Scotland; *Ballymena, in Ireland, and *Johannesburg, in South Africa.

*Repeat Orders

WEST'S GAS IMPROVEMENT COMPANY, LTD.

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LONDON: Columbia House, Aldwych, W.C. 2 — 'Phone: HOLBORN 4108 : 'Grams: "WESGASCO, ESTRAND, LONDON"

MEMBERS OF THE SOCIETY OF BRITISH GAS INDUSTRIES.

STOCK AND SHARE LIST

Official Quotations on the London Stock Exchange

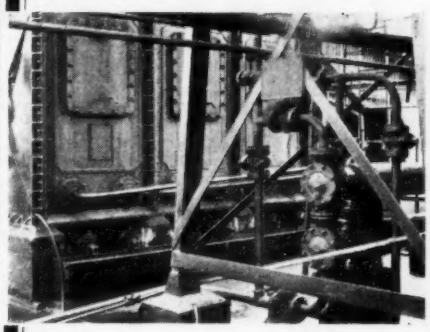
Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Aug. 28.	Rise or Fall on Week.	Transactions, Lowest and Highest Prices During the Week.
1,767,439	Stk.	Mar. 16	7	7⅛	Alliance & Dublin Ord. ...	164—169	...	168½
374,000	,,	June 22	4	4	Do. 4 p.c. Deb. ...	94—99	...	...
557,655	,,	Aug. 10	7	7	Barnet Ord. 7 p.c.	167—172	...	...
300,000	1	Mar. 30	1/4⅛	1/9⅜	Bombay, Ltd.	1⅛—1⅛	...	...
179,305	Stk.	Aug. 10	9⅛	9⅛	Bournemouth sliding scale ...	217—227	...	...
590,407	,,	,,	7	7	Do. 7 p.c. max. ...	168—173	...	170
493,960	,,	,,	6	6	Do. 6 p.c. Pref. ...	148—153	+2	151—152
50,000	,,	June 22	3	3	Do. 3 p.c. Deb. ...	84—89	...	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	105—110	...	...
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
357,900	,,	Aug. 10	7⅛	7⅛	Brighton, &c., 6 p.c. Con. ...	168—173	...	...
649,955	,,	,,	6¾	6¾	Do. 5 p.c. Con. ...	153—158	...	156
205,500	,,	,,	6	6	Do. 6 p.c. 'B' Pref.	142—147	...	...
855,000	,,	Mar. 2	7	8	British Ord.	158—163	...	...
100,000	,,	June 8	7	7	Do. 7 p.c. Pref.	151—156	...	...
350,000	,,	,,	5⅛	5⅛	Do. 5⅛ p.c. 'B' Cum. Pref.	108—113	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...	99—100
450 000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	110—115	...	...
200,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	97—99	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1—3	...	...
100,000	10	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1—3	...	...
150,000	Stk.	June 22	4½	4½	Do. 4½ p.c. Deb. ...	80—85	...	...
626.860	,,	July 20	6	6	Cardiff Con. Ord.	128—133	...	...
237,860	,,	June 8	5	5	Do. 5 p.c. Red. Deb.	108—113	...	...
609,204	1	Mar. 30	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	18/—20/-	...	...
296.053	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref.	22/—24/-	...	...
1,775,005	Stk.	Aug. 10	5	5	Commercial Ord.	95—100	...	96—97
620,000	,,	June 8	3	3	Do. 3 p.c. Deb. ...	84—89	...	87½
286.314	,,	Aug. 10	5	5	Do. 5 p.c. Deb. ...	118—123	...	...
807,560	,,	Aug. 10	7	7	Croydon sliding scale ...	157—162	...	161½
644,590	,,	,,	5	5	Do. max. div.	113—118	...	116½—117½
620.385	,,	June 22	5	5	Do. 5 p.c. Deb.... ...	123—128	...	...
239,000	,,	Aug. 10	5	5	East Hull Ord. 5 p.c....	107—110	...	...
184,555	,,	Aug. 10	6	6	East Surrey Ord. 5 p.c. ...	128—133	...	...
176,211	,,	June 8	5	5	Do. 5 p.c. Deb. ...	123—128	...	123½—124⅞
250,000	1	June 22	4	6	Gas Consolidation Ord. ...	20/6—22/6	...	22/—22/4½
250,000	1	May 18	4	4	Do. 4 p.c. Red. Cum. Pref.	19/—21/-	+-/6	20/—20/1½
19.284,128	Stk.	Aug. 10	5½	5½	Gas Light & Coke 4 p.c. Ord.	27/3—28/3a	...	27/6—28/-
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.... ...	89—92	...	90½—92
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	104—108	...	106½—107½
8,602,497	,,	May 18	3	3	Do. 3 p.c. Con. Deb. ...	87—90	...	89½—90
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	116—119	...	118—119½
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	114—117	...	115—117
700,000	,,	...	...	...	Do. 3½ p.c. Red. Deb. ...	103—105	...	...
270,466	,,	Aug. 24	6	6	Harrogate New Cons. ...	128—133*	−2	...
157,500	1	Mar. 16	1/7⅛	1/7⅛	Hongkong & China, Ltd. ...	1⅝—1⅞	...	25/6
213,200	Stk.	Aug. 10	6	6	Hornsey Con. 3½ p.c. ...	133—138	...	...
5,600,000	,,	May 18	8	12	Imperial Continental Cap. ...	140—150	−9½	142—153½
223,130	,,	July 20	3½	3½	Do. 3½ p.c. Red. Debs.	92—97	...	96—96½
285,242	,,	Aug. 24	8½	8½	Lea Bridge 5 p.c. Ord. ...	172—177†	−3	...
11,751	,,	,,	10	8	Maidstone Gas 5 p.c. Cap. Stk.	190—200*	+10	...
63,480	,,	June 22	3	3	Do. 3p.c.Prp.Db.Sk.	80—85	...	...
75,000	,,	May 18	†10	†10	Malta & Mediterranean ...	190—200	−5	...
392,000	—	Apl. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	102—107	...	...
231,978	Stk.	Aug. 24	5	5	M.S. Utility 'C' Cons. ...	110—115*	...	...
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	102—107*	−1	104⅜—106¾
360.075	,,	June 22	4	4	Do. 4 p.c. Deb. ...	104—109	...	...
148,955	,,	,,	5	‡5	Do. 5 p.c. Deb. ...	122—127	...	...
125,000	—	July 1	3½	3½	Do. 3½ p.c. Rd. Rg. Bds.	97—100	...	...
675,000	Stk.	June 22	†3	16	Montevideo, Ltd.	68—73	...	...
225,000	,,	Aug. 10	7½	7½	North Middlesex 6 p.c. Con.	170—175	...	...
396,160	,,	Aug. 10	5	5	Northampton 5 p.c. max. ...	110—115	...	...
300,000	,,	Apl. 20	†9	†7	Oriental, Ltd....	165—170	...	...
416,617	,,	June 8	8	8	Plymouth & Stonehouse 5 p.c.	168—173	...	...
504,416	,,	Aug. 10	8¼	8¼	Portsmouth & Gosport Cons.	170—175	...	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	112—117	+2	...
73,350	,,	,,	...	5	Do. 5 p.c. Pref. ...	118—123	...	...
114,000	,,	July 20	5	5	Preston 5 p.c. Pref.	110—115	...	...
355,698	1	Apl. 20	1/-	1/-	Severn Val. Gas Cor. Ld. Ord.	21/—23/-	...	22/-
454,510	1	Mar. 16	-/10⅛	-/10⅛	,, ,, 4½ p.c. Cum. Pref.	21/—23/-	...	...
133,201	Stk.	Aug. 24	5	8½	Shrewsbury 5 p.c. Ord. ...	145—150*	−2	...
90,000	10	June 8	‡3½	‡4	South African...	4—5	...	...
1,106,173	1	May 4	1/2¢	1/2¢	South East'n Gas Cn. Ld. Ord.	26/6—28/6	...	28/3
845,511	1	Mar. 16	-/10⅜	-/10⅜	Do. 4½ p.c. Red. Cum. Pref.	21/—23/-	...	...
200,000	1	,,	4	4	Do. 4 p.c. Cum. Pref. ...	20/9—21/9	...	...
450,000	Stk.	Aug. 10	4	4	Do. 4 p.c. Red. Deb. ...	100—103	...	...
6,709,895	,,	Aug. 10	6½	5	South Met. Ord.	124—127	...	124¼—126
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf....	145—150	...	...
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf....	103—106	...	...
1,895,445	,,	June 22	3	3	Do. 3 p.c. Deb. ...	87—90	...	88½—89¾
1,000,000	,,	July 6	5	5	Do. 5 p.c. Red. Deb.	114—117	...	115½
1,543,795	,,	Aug. 10	6	6	South Suburban Ord. 5 p.c....	129—134	...	132½—133
512,825	,,	,,	5	5	Do. 5 p.c. Pref....	120—125	...	...
500,000	,,	,,	4	4	Do. 4 p.c. Pref....	102—107	...	...
888,587	,,	June 8	5	5	Do. 5 p.c. Deb....	121—126	...	...
250,000	,,	,,	4	4	Do. 4 p.c. Deb....	102—107	...	...
427,859	1	May 4	9⅜	1/2⅜	S. Western Gas & Water Ord.	21,6—23/6	...	...
160,523	1	Apl. 20	...	-/10⅜	Do. 4½% Red. Cum. Pref.	21/—23/-	...	...
110,000	Stk.	June 22	4	4	Do. 4% Red. Deb. ...	100—105	...	...
647,740	,,	Aug. 10	5½	5	Southampton Ord. 5 p.c. ...	111—116	...	...
121.275	,,	June 8	4	4	Do. 4 p.c. Deb.	100—105	...	...
350,000	,,	Aug. 10	5½	5½	Swansea 5½ p.c. Red. Pref. ...	109—114	...	...
106,000	,,	June 8	6½	6½	Do. 6½ p.c. Red. Deb. ...	98—101	...	...
94,000	,,	,,	...	...	Do. 3½ p.c. Red. Deb. ...	95—100	...	...
1,076,490	,,	Aug. 10	6¾	6¾	Tottenham and District Ord.	148—153	...	151½—152
409,835	,,	,,	5¾	5¾	Do. 5½ p.c. Pref....	128—133	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
371,850	,,	June 8	4	4	Do. 4 p.c. Deb. ...	102—107	...	106½
369,774	,,	Aug. 10	7	7	Uxbridge, &c., 5 p.c. ...	155—160	...	...
108,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
1,340,521	,,	Aug. 10	7	7	Wandsworth Consolidated ...	157—162	...	160¾
1,371,373	,,	,,	5	5	Do. 5 p.c. Pref. ...	121—126	...	123½—125
500,000	,,	,,	...	...	Do. 4 p.c. Pref. ...	104½—106½	...	105¾—105⅞
1,317,964	,,	June 8	5	5	Do. 5 p.c. Deb. ...	122—127	...	...
338,300	,,	,,	4	4	Do. 4 p.c. Deb. ...	103—108	...	105
499,735	,,	Aug. 10	7½	7	Watford and St. Albans Ord.	153—158	...	...
200,000	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	123
200,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	131—136	...	...
200,000	,,	June 22	4	4	Do. 4 p.c. Red. Deb.	100—105	...	101 13/16
100,000	,,	,,	...	3½	Do. 3½ p.c. Red. Deb.	99—102	...	...
158,400	,,	Aug. 24	6b	5½	Winchester W. & G. 5 p.c. Con.	120—125*	+2	...

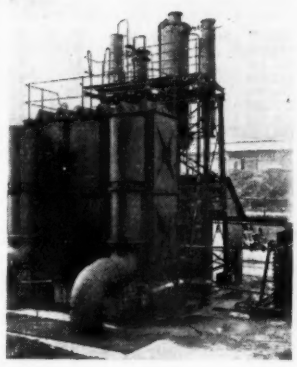
a.—The quotation is per £1 of Stock. b.—Paid £3, including 10s. on account of back dividends. * Ex div.
† Paid free of income-tax. ‡ For year.

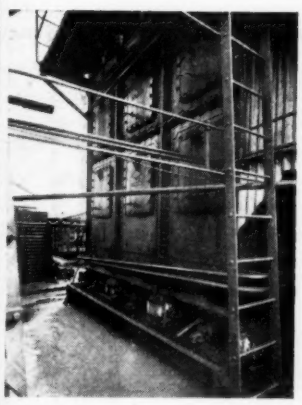
Stock and Share List continued overleaf.

Another large Gas Works

sends us this interesting new group of "Permac" Joints







The Engineer writes:—
"Under the exacting conditions of contact with Petroleum Distillates, which have great penetration powers, the Washer Joints made with "Permac" have remained perfectly sound over a period of two years."

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STOCK AND SHARE LIST—Cont.

Stocks Officially Quoted on Provincial Exchanges

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Aug. 28	Rise or Fall on Week.	Transactions, Lowest and Highest During the Week.
BRISTOL EXCHANGE.								
347,736	Stk.	July 20	6	5	Bath Cons.	122½—124½	...	...
1,667,250	,,	July 6	5	5	Bristol, 5 p.c. max.	120—122	...	...
120,420	,,	June 8	4	4	Do. 1st 4 p.c. Deb. ...	101½—103½	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	101½—103½	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	124—127	...	...
274,000	,,	Aug. 10	5	5	Newport (Mon.) 5 p.c. max....	110—114	...	...
13,200	12	Mar. 16	7	8½	Pontyp'l Gas & W. 10 p.c. 'A.'	14—15	...	...
13,600	10	,,	5	6	Do. 7 p.c. B.'	11½—12½	...	...
40,000	10	,,	5	6	Do. 7 p.c. 'C.'	11½—12½	...	...
140,778	Stk.	Aug. 10	5	5	Weston-super-Mare Cons. ...	112—114	...	...
64,338	,,	June 22	4	4	Do. 4 p.c. Deb.	96½—98½	...	...
33,340	,,	,,	7½	7½	Do. 7½ p.c. Deb.	163—166	...	...
LIVERPOOL EXCHANGE.								
157,150	Stk.	Aug 10	6½	5	Chester 5 p.c. Ord.	107—112	...	...
92,500	,,	June 8	4	4	Do. 4 p.c. Pref.	98—102	...	...
32,540	,,	,,	3½	3½	Do. 3½ p.c. Deb. ...	90—95	...	...
41,890	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	99—103	...	...
2,167,410	,,	Aug. 24	6	6	Liverpool 5 p.c. Ord. ...	133—135*	−2	...
245,500	,,	June 22	5	5	Do. 5 p.c. Red. Pref ...	103—108	...	...
306,083	,,	July 6	4	4	Do. 4 p.c. Deb. ...	104—106	...	...
106,280	,,	July 20	10	10	Preston 'A' 10 p.c. ...	198—208	...	...
189,219	,,	,,	7	7	Do. 'B' 7 p.c.	137—147	...	...
NEWCASTLE EXCHANGE.								
122,577	Stk.	Aug. 10	8	8	Blyth 5 p.c. Ord.	151—153	...	...
732,000	,,	Feb. 3	5	5	Hartlepool G. & W. Co. & New	120—122	...	...
2,061,315	,,	Aug. 10	5½	5	Newcastle & Gateshead Con.	27/—27.9a	+-, 1½	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	103—105	...	...
776,706	,,	June 22	3½	3½	Do. 3½ p.c. Deb. ...	99—101	...	...
277,285	,,	May 4	5	5	Do. 5 p.c. Deb. '43...	103—104	...	...
209,820	,,	Aug. 10	8½	8½	South Shields Con.	171—173	...	...
299,542	,,	Aug. 10	6	6	Sunderland 6 p.c. max. ...	127—129	...	...
NOTTINGHAM EXCHANGE.								
542,270	Stk.	Aug. 10	10	7	Derby Con.	174—184	...	...
55,000	,,	June 22	4	4	Do. 4 p.c. Deb.	100—105	...	...
84,750	,,	Feb. 17	5	12	Long Eaton 'A' Ord. ...	...	...	...
50,000	,,	,,	4	10	Do. 'B' Ord. ...	...	...	...
20,000	10	June 8	5	5	Do. 5 p.c. Pref. ...	10—12	...	...
80,000	Stk.	,,	5	5	Do. 5 p.c. Deb. ...	117—122	...	...
SHEFFIELD EXCHANGE.								
10,000	Stk.	Aug. 10	10	10	Great Grimsby 'A' Ord. ...	220—230	...	...
6,500	,,	,,	10	10	Do. 'B' Ord. ...	220—230	...	...
79,000	,,	,,	10	10	Do. 'C' Ord. ...	205—215	...	...
1,806,339	,,	Aug. 24	6	6	Sheffield Cons.	144—146	−2	...
95,000	,,	July 6	4	4	Do. 4 p.c. Deb.	99—101	...	...

a The quotation is per £1 of Stock.

Supplementary List of Stocks and Shares not Officially Quoted

202,152	Stk.	...	...	...	Ascot Ord.	119—124	...	...
128,182	,,	July 6	...	5	Do. 5 p.c. Pref.	115—120	...	...
238,631	1	June 8	5	5	Assd. Gas and Water Ord. ...	21/—23/-	...	...
323,681	1	,,	4½	4½	Do. 4½ p.c. Cum. Pref. ...	21/6—23/6	...	...
150,000	Stk.	...	...	...	Do. 3½ p.c. Red. Deb. ...	99—102	...	...
17,000	,,	Aug. 24	8	8	Bognor Orig. Ord. 'A' ...	175—185*	...	...
62,210	,,	,,	8	8	Do. New Addl. 'A' ...	175—185*	...	...
87,168	,,	,,	7	7	Do. New 7 p.c. max. ...	145—150*	...	...
37,440	,,	Aug. 10	10	10	Cam.Univ. & Town 10 p.c.max.	205—215	...	...
125,970	,,	,,	7	7	Do. 7 p.c. max.	155—160	...	...
39,025	,,	,,	5	5	Do. 5 p.c. max.	108—113	...	...
65,000	,,	Aug. 10	8½	7½	Eastbourne 'A' 5 p.c. ...	168—173	...	...
198,000	,,	,,	7	6	Do. 'B' 3½ p.c.	140—145	...	143
112,312	,,	,,	5	5	Do. 5 p.c. Pref.	118—123	...	...
130,000	,,	June 22	5	5	Do. 5 p.c. Deb.	124—129	...	126
24,000	30	Aug. 10	8½	8½	Great Yarmouth 8½ p.c. max.	51—56	...	...
59,400	30	,,	7½	7½	Do. 7½ p.c. max.... ...	42—45	...	...
81,160	Stk.	June 8	5½	5½	Do. 5½ p.c. Deb.... ...	123—128	...	...
152,600	,,	Mar. 2	8	8	Guildford Cons.	185—195	...	...
54,055	,,	,,	5	5	Do. 5 p.c. Pref.	114—119	...	...
68,250	,,	June 8	5	5	Do. 5 p.c. Deb.	120—125	...	...
156,600	,,	Aug. 24	7½	7½	Hampton Court Cons. ...	173—178*	...	...
107,960	10	Mar. 16	4	5½	Mid Kent Ord.	10—11	...	...
230,940	Stk.	Aug. 10	10	10	Oxford & District Ord. ...	205—215	...	...
47,112	,,	,,	5	5	Do. 5 p.c. Pref.	118—123	...	...
50,000	,,	,,	6	6	Do. 6 p.c. Red. Pre ...	113—118	...	...
126,193	,,	May 18	7½	7½	Peterborough Ord.	160—170	...	175
64,990	,,	Mar. 16	6½	7½	Redditch Ord.	135—140	...	...
166,850	,,	Aug. 10	9	8	Romford Ord.	168—178	...	...
60,000	,,	,,	4	4	Do. 4 p.c. Pref.	97—100	...	...
44,000	,,	Mar. 16	5	5	Do. 5 p.c. Deb.	122—127	...	...
10,950	,,	Aug. 24	8	8	Ryde Ord.	165—170*	...	...
136,191	,,	Aug. 10	7	5	Scarborough Ord.	126—136	...	...
27,825	,,	Aug. 24	8	8	Shanklin & Ventnor Cons. ...	162—172*	−3	...
40,643	,,	Mar. 2	7	7	Slough Ord.	147—152	...	...
221,000	,,	June 22	5	5	Do. 5 p.c. Deb.	116—121	...	...
28,872	1	May 4	5½	5½	S. Midland Gas Cpn.Ltd. Ord.	20/—22/-	...	...
28,866	1	Mar. 16	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	22/—24/-	+2/-	23/6—23/9
137,730	Stk.	Aug. 10	7	7	Southgate & Dist. 7 p.c. max.	151—156	...	...
62,500	,,	,,	5	5	Do. 5 p.c. Pref.	115—120	...	...
117,228	,,	Aug. 10	6	5	Swindon Cons.	110—115	...	...
60,425	,,	June 22	5	5	Do. 5 p.c. Deb.	120—125	...	...
64,380	,,	June 8	5	5	Torquay and Paignton 5 p.c. Pf.	117—122	...	...
50,000	1	Mar. 30	...	5·52d.	a Utd. Kingdom Gas Cpn. Ord.	21/3—22/3	...	21.9—22/-
769,910	1	,,	2½	2½	Do. 4½ p.c. Prefd. Ord....	20/—22/-	...	20.9—22/6
110,910	1	May 18	2½	4½	Do. 4½ p.c. Cum. Pref. ...	21/6—22/6	...	22/-—22/0½
900,000	Stk.	Mar. 16	...	3½	Do. 3½ p.c. Red. Deb. ...	98—101	...	100½
130,000	,,	Aug. 10	8	5	Wakefield Ord.	140—145	...	...
81,650	,,	,,	5	5	Do. 5 p.c. max.	105—110	...	...
82,000	,,	July 20	6	6	Weymouth Ord.	105—110	...	...
98,384	,,	Aug. 10	6	6	Wolverhampton 6 p.c. Pref.	127—132	...	...
160,000	,,	June 8	5½	5½	Do. 5½ p.c. Rd. Db	107—112	...	...
370,000	,,	July 20	6	4	York Cons.	105—110	...	...
90,000	,,	June 22	5	5	Do. 5 p.c. Red. Deb. ...	103—108	...	...
133,640	,,	July 20	6½	6½	Yorkstown (Cam.) 5 p.c. Cons.	130—135	...	...
120,000	,,	,,	5	5	Do. 5 p.c. Pref.	118—123	...	...
35,000	,,	June 22	5½	5½	Do. 5½ p.c. Deb.... ...	130—135	...	...

a Assual.

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